U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-268 708

Sanitary Landfill Operator's Manual

Iowa Dept of Environmental Quality, Des Moines

May 77

PB 268 708

Sanitary Landfill Operators' Manual

MAY 1977

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY

LAND QUALITY MANAGEMENT DIVISION

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NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.

2.

3. RECIPIENT'S ACCESSION NO.

4. TITLE AND SUBTITLE
Sanitary Landfill Operators' Manual

5. REPORT DATE
May 1977

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Land Quality Management Division
Iowa Department of Environmental Quality
Des Moines, Iowa

10. PROGRAM ELEMENT NO.

11. CONTRACT/GRANT NO.

12. SPONSORING AGENCY NAME AND ADDRESS
Same as above

13. TYPE OF REPORT AND PERIOD COVERED

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
COLOR ILLUSTRATIONS REPRODUCED IN BLACK AND WHITE

16. ABSTRACT

This manual gives specific requirements and suggested procedures for operating a sanitary landfill. Some of the problems, which could develop at a sanitary landfill, and how to avoid them are discussed. Solid waste rules from the Code of Iowa and from the Iowa Department of Environmental Quality are included, as well as surveying techniques.

The following topics are presented:

Cont'd P. i(a)

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Iowa, Operators' Manuals, Sanitary Landfills, Solid Waste Disposal		

18. DISTRIBUTION STATEMENT
Unlimited Distribution sponsored by EPA

19. SECURITY CLASS *(This Report)*

20. SECURITY CLASS *(This page)*

21. NO. OF PAGES
146

22. PRICE
PCA07
MFA01

EPA Form 2220-1 (9-73)

Cont'd from BDS

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CHAPTER 1

SANITARY LANDFILLS

A sanitary landfill is defined in the rules of the Iowa Department of Environmental Quality as "a method of disposing of solid waste on land by utilizing the principles of engineering to confine the solid waste to the smallest practical volume and to cover it with a layer of earth so that no nuisance or hazard to the public health is created".

What this generally means is that a property is selected as a potential site, an engineer studies it thoroughly and develops a plan by which he feels it can safely handle the waste to be disposed of. If the Department agrees that this is the case and that the site as designed does meet the requirements of the rules in Appendix B then a permit is issued.

About now the operator generally inherits the site. Some of the initial construction, like buildings, may already be done for him. If he's real lucky main roads and the initial earthwork will also be done.

With whatever he is given the operator must understand what is supposed to happen and get it done.

If you oversimplify, this means getting the solid waste to where it is supposed to be deposited; compact it and cover it. But it certainly isn't that simple. There are all sorts of problems that may be encountered. there are many additional duties to be performed. And if anything goes wrong, it may take a great deal of time and money to correct the problem in order to avoid contamination of surface streams or groundwaters.

In the following chapters specific operating requirements will be discussed as will some of the problems which could develop at a sanitary landfill and how to avoid them.

The law, which required the permitting of sanitary landfills and other sanitary disposal projects, is included in Appendix A. The solid waste disposal rules are in Appendix B. Appendixes C andD illustrate specific surveying techniques which maybe useful.

CHAPTER 2

SANITARY LANDFILL OPERATION

SANITARY LANDFILL METHODS - INITIAL SITE PREPARATION

With any sanitary landfill a certain amount of work must be done before any solid waste is accepted in order to ensure that a good day-to-day operation is possible. This would include:

1. Constructing the roads on the site;
2. Installing fencing, gates, monitoring wells, signs, and buildings; and
3. Doing whatever earthwork is needed.

The earthwork required may only be removal of the topsoil from the first part of the site to be filled. However, it will more likely involve excavating 5,000 to 100,000 cubic yards of soil. In addition, it may be necessary to remove sand, gravel or rock encountered in excavating the site, compact one or more layers of soil to a particular density, or install drainageways, berms, dikes, terraces, tile lines or other structures as specified in the permitted plans. Since the amount of work involved depends on the waste, the site and the engineers design, it is impossible to predict what will be needed without looking quite closely at the plans and the permit.

TYPE OF SANITARY LANDFILLS

There are two basic types of sanitary landfills - the area type and the trench type. However, there are many combinations and variations of these.

Trench Type

The trench type of sanitary landfill (Figure 2.1) is usually used on level ground or on gently sloping ground where the water table is low enough to make excavation feasible. The excavated soil is stockpiled along the upper edge of the trench, usually along the windward side. This keeps cover material handy and also tends to control the wind and keep surface water from draining into the trench. Daily cells are then constructed across the trench on about a 3 to 1 working face slope (Figure 2.2) so that each cell would be built on the previous days cell (Figure 2.3).

FIGURE 2.1
A trench type sanitary landfill

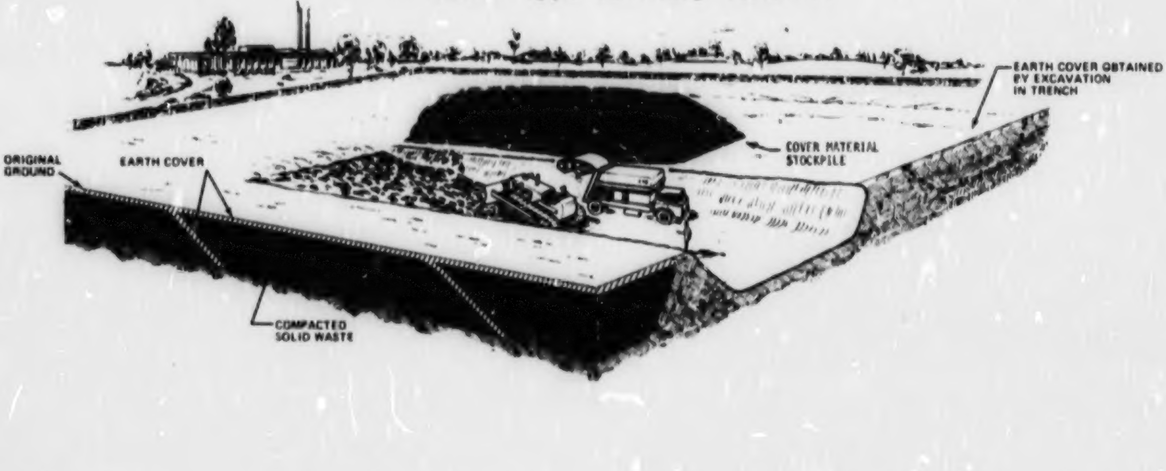


FIGURE 2.2
Cross section showing construction of a daily cell

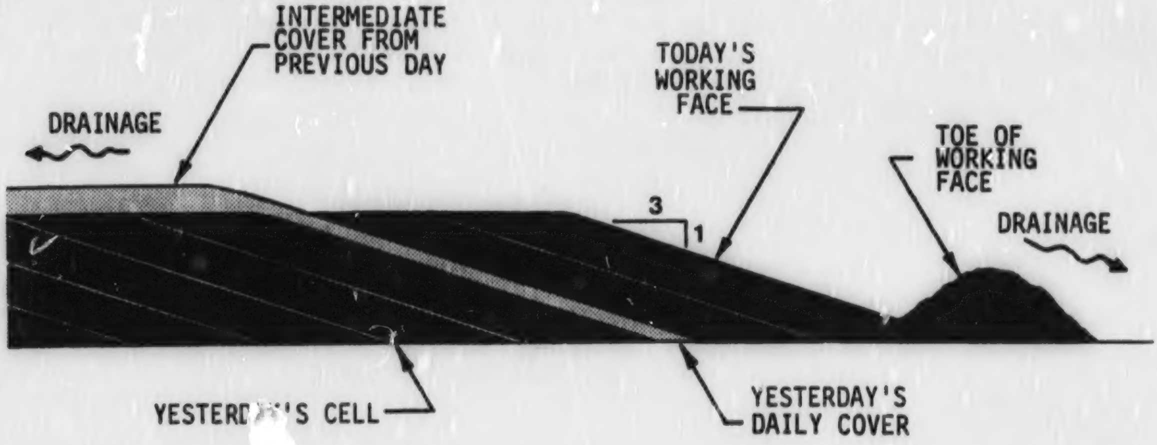
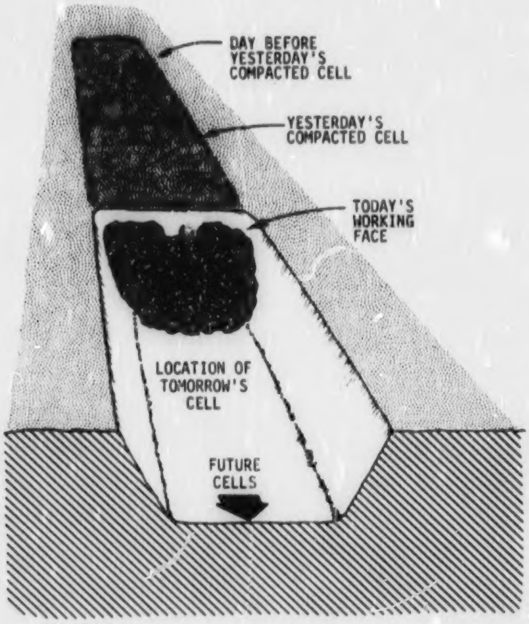

INTERMEDIATE COVER FROM PREVIOUS DAY
TODAY'S WORKING FACE
DRAINAGE
TOE OF WORKING FACE
DRAINAGE
3
1
YESTERDAY'S CELL
YESTERDAY'S DAILY COVER

FIGURE 2.3
Sequence of filling a trench


DAY BEFORE YESTERDAY'S COMPACTED CELL
YESTERDAY'S COMPACTED CELL
TODAY'S WORKING FACE
LOCATION OF TOMORROW'S CELL
FUTURE CELLS

Trenches should be dug perpendicular to the prevailing wind, if possible, so as to minimize litter problems. If that is not possible, the trench should be dug so that the wind will hold the solid waste on the working face.

Trenches must be dug so as to provide water drainage away from the working face. This is generally done by cutting the trench so that water drains down the trench and out its mouth (Figure 2.4). Although much less desirable, the trench may in some special circumstances also be dug to drain to a sump form which the water is pumped out (Figure 2.5).

FIGURE 2.4
Side view of a trench cut to drain toward surface

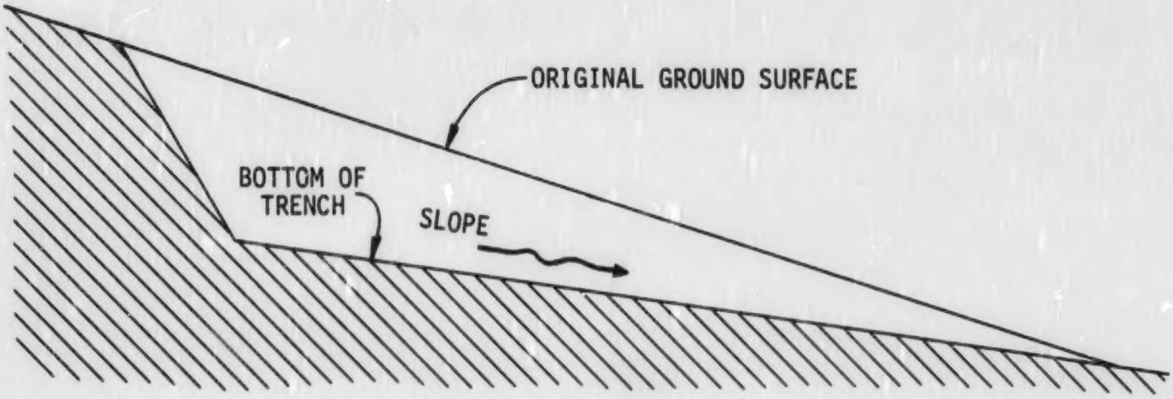
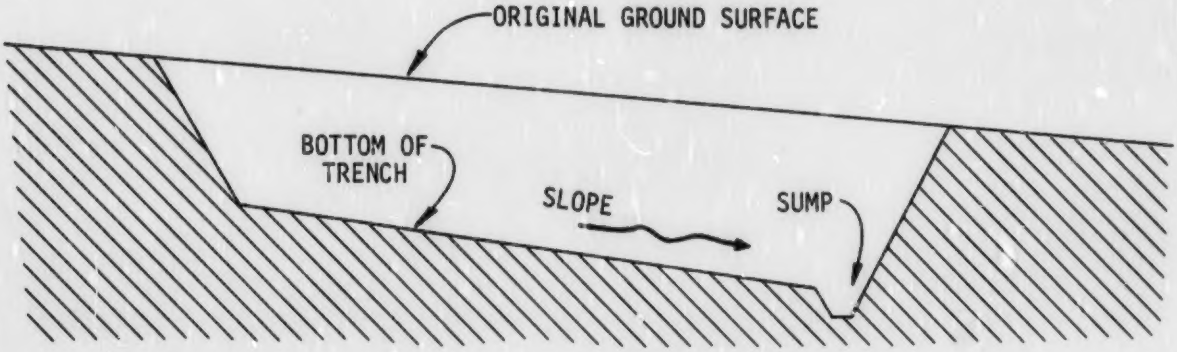
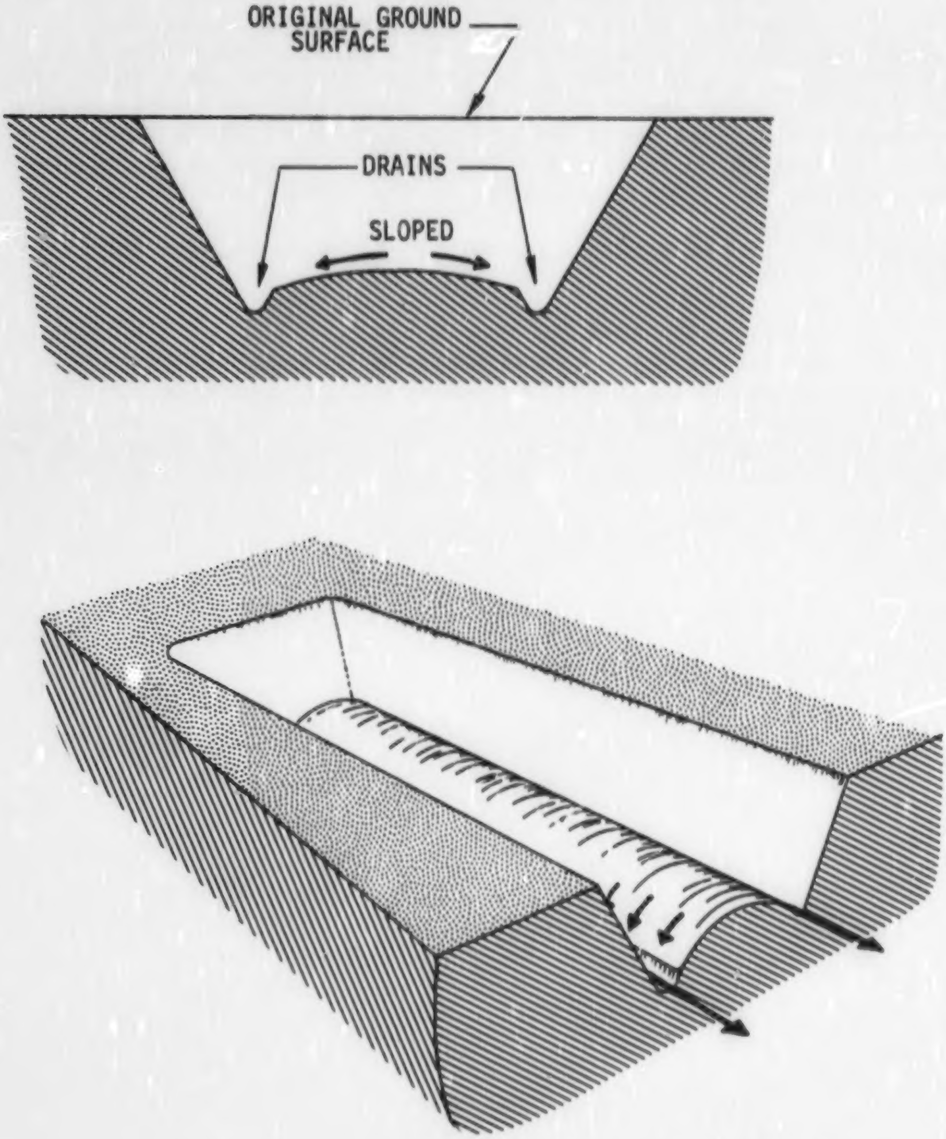

ORIGINAL GROUND SURFACE
BOTTOM OF TRENCH
SLOPE

FIGURE 2.5
Side view of a trench cut to drain toward a sump


ORIGINAL GROUND SURFACE
BOTTOM OF TRENCH
SLOPE
SUMP

It is also a very good idea to have the bottom of the trench sloped to one (or both) sides (Figure 2.6) so that part of the trench remains dryer during wet weather. This lets vehicles drive up and down the bottom of the trench in wetter weather particularly if the high portion is well rocked.

FIGURE 2.6
Construction of a trench to provide drainage


ORIGINAL GROUND SURFACE
DRAINS
SLOPED

Trenches have the advantages of:

1. Providing a windbreak to limit litter;
2. limiting the size of the working face;
3. providing a visible check for determining how deep to fill; and,
4. not significantly changing the surface elevation of the site.

Trenches have the disadvantages of:

1. Leaving the walls of dirt between trenches unused, thereby not getting as much solid waste into a site;
2. limit working face width which may delay vehicles delivering solid waste if a great number are coming to the site; and,
3. periodically requiring the excavation of an entire trench thereby requiring additional equipment and manpower for a short time.

Trenches should be at least one and one-half times the width of the equipment doing the compacting so that all the solid waste can be properly compacted. This width allows complete coverage of the solid waste by the tread or wheels of the compacting equipment. Likewise, the trench should be no wider than necessary for unloading and compacting. For example, a trench twenty to thirty feet wide would:

1. Let vehicles pass the compaction equipment in the trench;
2. let two or three packer trucks unload at the operating face; or,
3. let one or two vehicles unload at the operating face while the compaction equipment is on the face. Some trenches have been constructed up to 150 feet wide but with these trenches the actual method of operation is really an area type sanitary landfill within the trench.

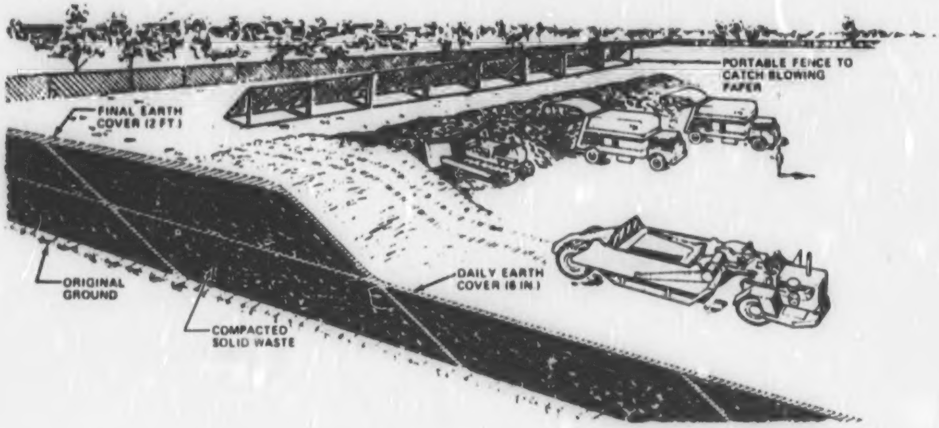
Area Type

Area type sanitary landfills (Figure 2.7) are usually placed where:

1. High water tables or other geological factors prevent trenching;
2. a large working face is desired;
3. the added capacity of several lifts of daily cells is deisred; or,
4. the final use (such as filling a low area or making a ski hill) suggests the area type of operation.

In the area type sanitary landfill the solid waste is also deposited against a 3:1 slope but the working face is not limited in width by the sides of a trench. The only limit on the width of the daily cell is the length of the berm or previous day's cell against which today's cell could be compacted. (Figure 2.8).

FIGURE 2.7
Area type sanitary landfill



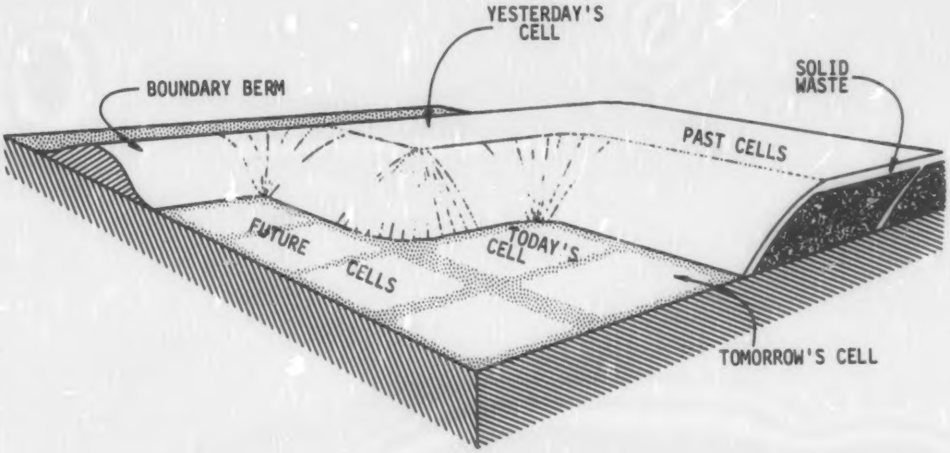
Advantages of an area type sanitary landfill include:

1. Several lifts can be put in so that capacity of the site is limited only by the quantity of cover material and the depth to which the site can be filled;
2. the size of the operating face can be adjusted to handle the amount of solid waste being received on a given day;
3. excess cover material in other parts of site can be brought in and used; and
4. work proceeds at a steady rate less likely to periodically need more equipment for a short time for major excavation.

Disadvantages of an area type sanitary landfill include:

1. Greater difficulty in limiting the working face to the smallest practical width;
2. greater potential for litter problems due to the exposed nature of the fill; and,
3. cover material must be brought in every day - often from some distance requiring additional equipment.

FIGURE 2.8
Sequence of filling an area type sanitary landfill


YESTERDAY'S CELL
SOLID WASTE
BOUNDARY BERM
PAST CELLS
FUTURE CELLS
TODAY'S CELL
TOMORROW'S CELL

Other Methods

There are many vairations of the area and trench types of sanitary landfills, but they are all just variations. These include:

1. Cutting a very large trench or using a ravine with an area type of operation within the trench;
2. putting an area type sanitary landfill over or adjacent to a trench type operation (Figure 2.9);
3. "cut and cover" trenching (Figure 2.10); and,
4. the ramp method of operating an area type sanitary landfill (Figure 2.11).

FIGURE 2.9
Area type sanitary landfill operation over a trench type sanitary landfill operation

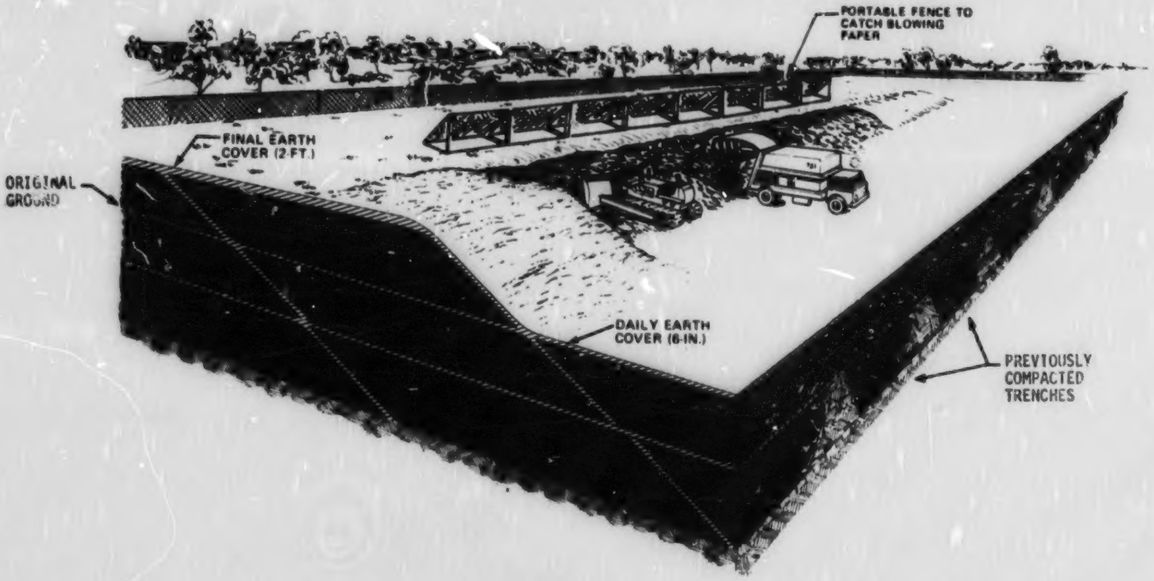

PORTABLE FENCE TO CATCH BLOWING PAPER
FINAL EARTH COVER (2 FT.)
ORIGINAL GROUND
DAILY EARTH COVER (6-IN.)
PREVIOUSLY COMPACTED TRENCHES

FIGURE 2.10
Cut and cover type of sanitary landfill

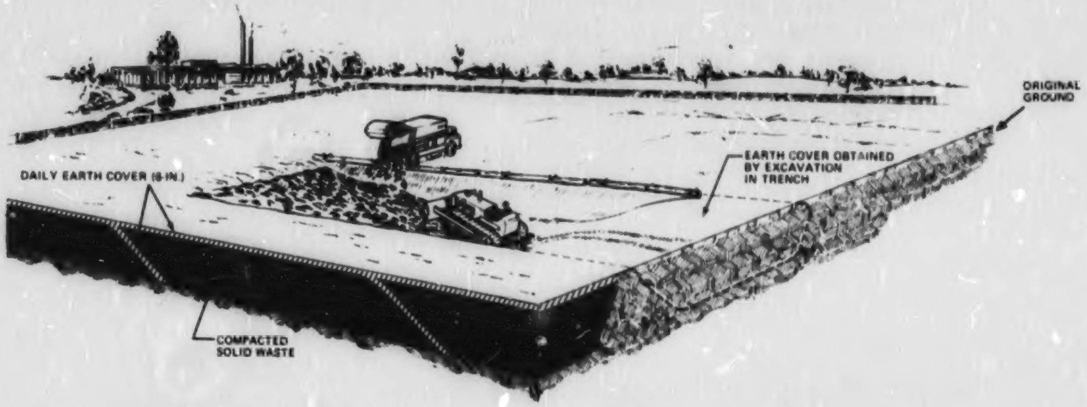
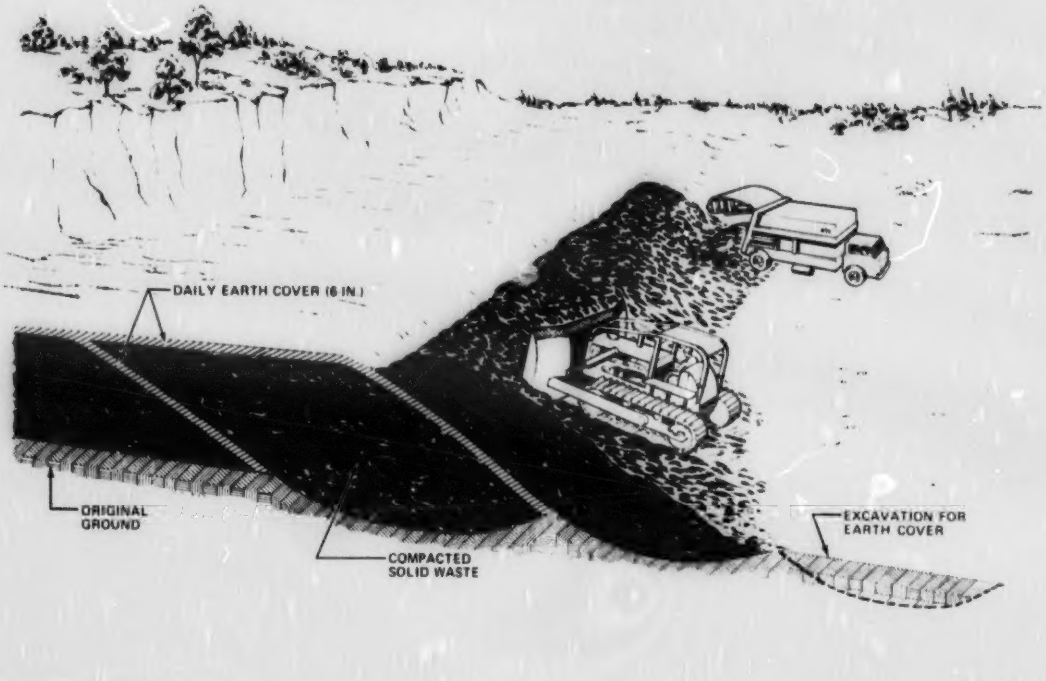

ORIGINAL GROUND
EARTH COVER OBTAINED BY EXCAVATION IN TRENCH
DAILY EARTH COVER (6 IN.)
COMPACTED SOLID WASTE

FIGURE 2.11
Ramp type sanitary landfill


DAILY EARTH COVER (6 IN.)
ORIGINAL GROUND
COMPACTED SOLID WASTE
EXCAVATION FOR EARTH COVER

The advantages, the disadvantages and the methods of operation are the same as with a very large trench, a ravine operation, or an area fill on top of or adjacent to trenches, as with normal trench type and area type sanitary landfills.

With the "cut and cover" method, the trench is excavated just ahead of the working face as cover material is needed (Figure 2.10). This method is seldom used in Iowa for three reasons. First, it forces the truck to unload from the top edge of the trench, giving the wind a chance to blow paper and other light materials across the site and requiring more effort to compact the solid waste. Second, the soil must be excavated each day for cover material and to provide room for future solid waste. This can be difficult and expensive when the soil is frozen or even when wet (if the soil is tightly packed and gets slick when wet). And third is lack of drainage. Generally water cannot be drained from the working face and causes both leaching of contaminants and operating problems.

With the ramp type of area fill (Figure 2.11) the cover material is excavated immediately in front of the working face is needed. This method is also seldom used in Iowa for several reasons. First, access to the toe of the working face is hindered by the excavation. This results in either limiting access to good weather or requiring that waste be dumped from above, with the resulting litter problems and additional difficulty compacting the solid waste. Second, the soil must be excavated each day to provide cover material. This can be both difficult and expensive during winter frost conditions. Third, this type of operation results in a low spot right in front of the working face which is difficult to drain. As a result the operator must spend considerably more time finishing the toe of the working face so that water will drain out of the low spot and away from the working face. If the site is not located on a steep enough slope special drainage trenches may have to be maintained to provide drainage.

Each situation is evaluated by the consulting engineer and, when approved by the Iowa Department of Environmental Quality, his plan of operation must be followed until and unless a change is approved by the Iowa Department of Environmental Quality.

SPECIAL USE SANITARY LANDFILLS

Sometimes it is convenient to have a separate sanitary landfill site exclusively for a special type of solid waste. The most common of these is a construction and demolition waste disposal site, although other special use sites have been developed.

Construction and Demolition Waste Disposal Sites (C&D Sites)

Sanitary landfills designed to receive only construction and demolition wastes or special areas of a regular sanitary landfill which have been set aside strictly for construction and demolition wastes are operated much the same as a conventional sanitary landfill. The only exception is that construction and demolition sites do not need to be covered daily. Instead they must be covered weekly or more often as needed for fire control. However, this weekly cover must be at least one (1) foot thick instead of only six inches thick as required for daily cover at a regular sanitary landfill. Other than larger cells, the site is run just like a conventiaonal sanitary landfill with the waste being spread and compacted in 1 foot to 2 feet layers.

OTHER AREAS ON A SANITARY LANDFILL

Salvage Areas

Scavaging is never to be allowed at a sanitary landfill. Once solid waste has been delivered to the working face and hits the ground it is to be left there and disposed of. No one may be allowed to pick up anything. Not the public. Not the operators.

It may seem wasteful to throw usable material into a sanitary landfill. Anything that can be economically recycled, or any resource that can be covered should never get to a sanitary landfill. However, once there, tight controls must be kept over the waste to keep the site from becoming an old fasioned dump and to protect the people using and working at the site.

Scavengers have been run over by crawler tractors, hit by trucks, injured and killed.

However, if enough of a certain reusable or recyclable material is being received, the permit holder can apply for permission from the Iowa Department of Environmental Quality to salvage this material. The salvage area must be located and described in the engineering plan and approved before beginning the salvage operation.

The salvaging must be conducted in an orderly, sanitary method in a controlled area away from the working face. Material cannot be picked up from the working face but must be dropped off in the salvage area before it reaches the working face.

Before any salvage operation is started, you also need to contact a buyer that will take the material. The market for salvaged material has been very unstable with rapid price changes. It is very important that you have an outlet for this material or you may end up burying it anyway. New buyers have started up, others have quit and still others have severely cut back their purchases. The Iowa Department of Environmental Quality may be able to help locate buyers.

Building

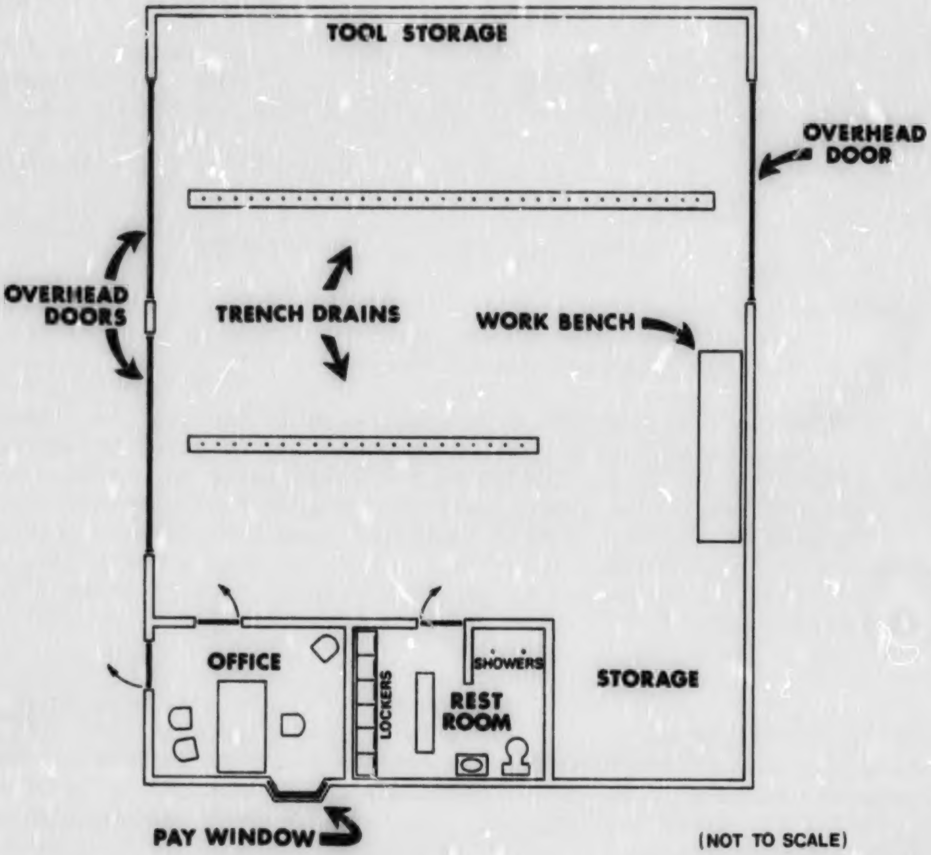
The availability of an adequate maintenance building can be a great help in providing proper maintenance of euqipment, particularly through the winter when frozen materials can accumulate on the vehicle and in weather when you don't want to do routine maintenance outside.

In addition, it is necessary that a shelter be provided for the employees with sanitary and personal washing facilities.

As a result many solid waste agencies have constructed buildings similar to the one shown in Figure 2.12 which provides maintenance areas for two pieces of equipment. One of the bays is built in such a way that a vehicle could be towed into it if necessary. Also provided is an office for record keeping and a restroom with a shower in case of an accident with toxic or hazardous waste.

This building is more than adequate to satisfy the Iowa Department of Environmental Quality's rules but does provide for the large amount of maintenance that sanitary landfill equipment requires and also provides the employee with a place to clean up.

FIGURE 2.12
A typical maintenance and office building


TOOL STORAGE
OVERHEAD DOOR
OVERHEAD DOORS
TRENCH DRAINS
WORK BENCH
OFFICE
LOCKERS
SHOWERS
REST ROOM
STORAGE
PAY WINDOW
(NOT TO SCALE)

Burning Areas

The Rules and Regulations of the Air Quality Commission of the Iowa Department of Environmental Quality allow a few specific exceptions to the general prohibition against open burning. Generally the only one that involves a sanitary landfill is the open burning of diseased trees.

Diseased trees may be burned at a sanitary landfill if the site has been permitted to do so by the Iowa Department of Environmental Quality and meets a few general requirements. These requirments are that the diseased tree burning area must be:

1. At least 500 feet from the working face so that the working face doesn't catch fire;
2. the access to the area must be controlled to prevent the depositing of other solid wastes in the area (if anything else is deposited in the area it must be picked up and returned to the working face); and finally,
3. only gasoline, oil, or similar petroleum fules shall be used to ignite the diseased trees.

RESPONSIBILITIES OF THE OPERATOR

In addition to the specific operation details of disposing of the solid waste, there are a number of things which should also be done as part of the normal day to day operations of a well run sanitary landfill.

One is to maintain a neat and orderly appearance at the sanitary landfill. By doing this, the general public will be more willing to drive to where you want them to unload instead of just dropping the solid waste anywhere. This also leads right into the second job of maintaining good public relations. A neat and orderly site is the single most important aspect of being a good neighbor and a source of local pride. This local support not only makes life easier and more pleasant but is needed to get thefinancial support necessary to properly run a sanitary landfill and is mandatory in order to find a new sanitary landfill site when the present one is completed.

With a good public image, local government officials will hear fewer complaints and will be easier to work with. This is important because they influence your operating revenues either directly, by running the site or through their contract with you, or indirectly, by their regulation of solid waste collection and disposal practices. Likewise, they can be a help to you by encouraging people to use commercial collectors instead of driving to the site or by encouraging the use of bags to help control litter.

Special precautions should be taken to avoid accidents. No one wants to get hurt, but in the case of a sanitary landfill operator its even worse because the waste will keep right on coming. If the equipment won't work or the operator can't, the waste will still be their waiting to be compacted and covered. Back-up equipment may be slow in coming or may not work as well. A new back-up operator probably won't be as familiar with how to do things or may not care. Either way its much harder to catch up than it is to keep things running smooth.

Operating on slopes, with unexpected hazardous or hard to handle material arriving and the general public wandering around, provides plenty of opportunity for accidents. Therefore, it is a good idea to have, and know how to use, a first aid kit (with eye wash packs), a fire extinguisher and a way to communicate with other sanitary landfill employees.

CHAPTER 3

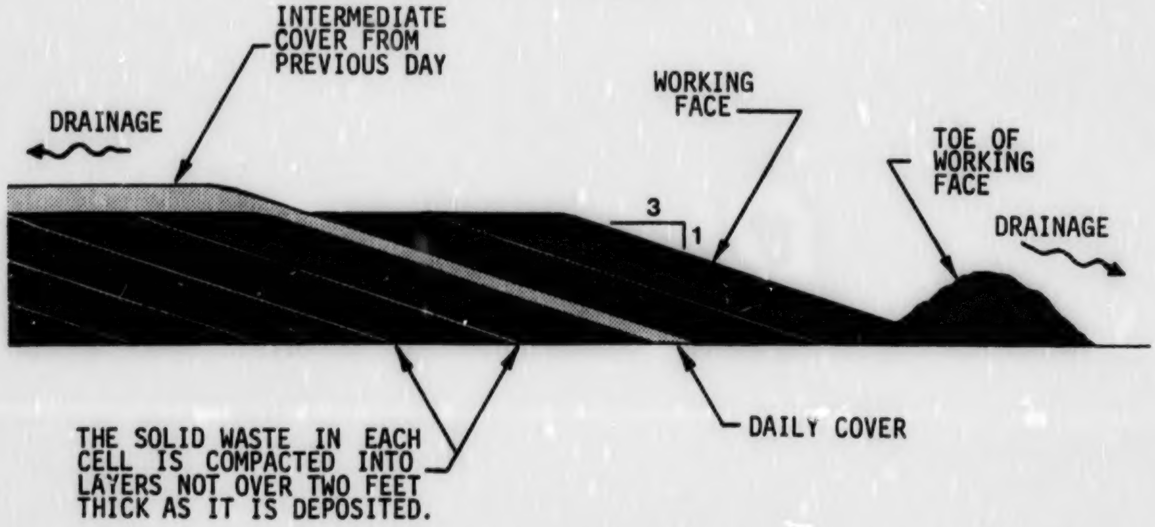
CELL CONSTRUCTION

The most important part of day to day operation of a sanitary landfill is the proper construction of the daily cell. If not constructed or if poorly constructed a number of problems may develop including:

1. attracting and harboring flies, rats, birds and other disease carrying vectors;
2. filling of the site at a rate that is faster than necessary;
3. excessive settling;
4. production and release of leachates; and,
5. loss of available cover material.

All of these take time and money to correct. When completed, a daily cell will appear to be a firmly packed bank of earth smoothed to provide good drainage with no visible solid waste. This is accomplished by starting with a slope of approximately 3:1 along yesterdays finished daily cell, a specially constructed berm or the end of the trench. Solid waste is then compacted against this slope in successive layers which should not be over two (2) feet thick (Figure 3.1).

FIGURE 3.1
Cross section of a daily cell showing the compacted layers of solid waste


INTERMEDIATE COVER FROM PREVIOUS DAY
DRAINAGE
WORKING FACE
TOE OF WORKING FACE
DRAINAGE
3
1
DAILY COVER
THE SOLID WASTE IN EACH CELL IS COMPACTED INTO LAYERS NOT OVER TWO FEET THICK AS IT IS DEPOSITED.

If the layers are more than two feet thick the bottom of each layer will not be very well compacted no matter how many times you drive over the waste. Once this waste has been spread it must be compacted by driving over it at least three to five times in order to get adequate compaction. It must be stressed that this means three to five passes over each exposed item of solid waste (Figure 3.2). If you make more than five passes, you will compact the solid waste even more as shown in Figure 3.3. However, overall compaction would be much better if you make five passes over two layers each of which is one foot thick than if you make 10 passes over one layer that is two feet thick.

FIGURE 3.2
Compacting with a tracked vehicle

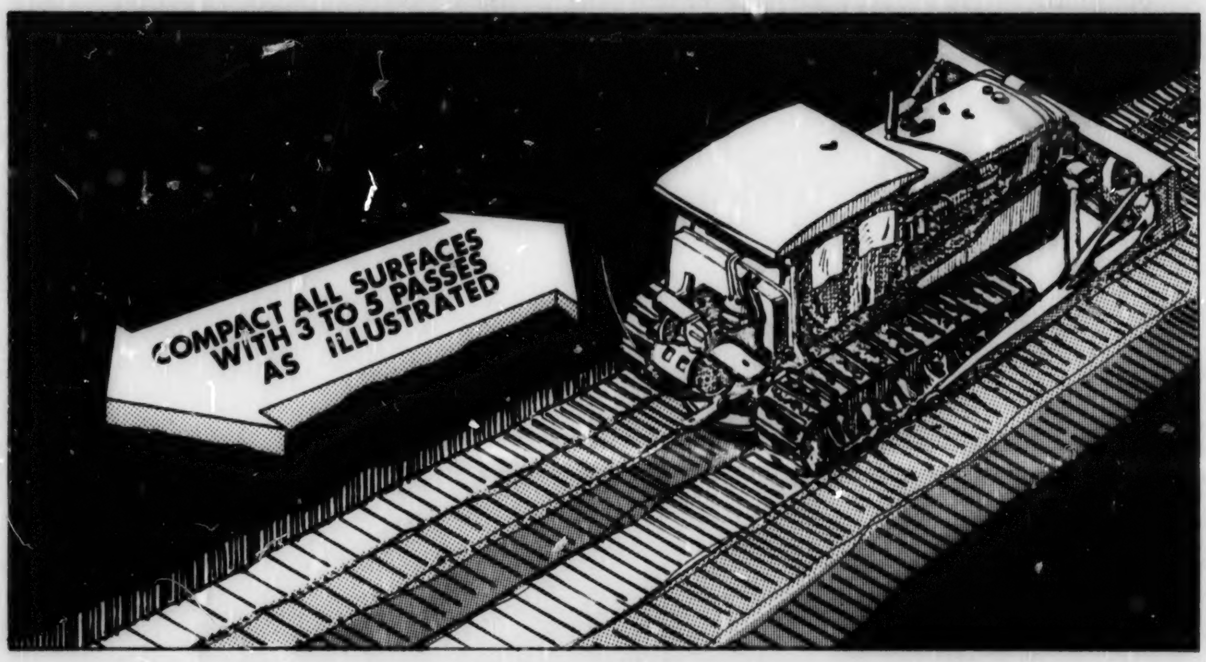
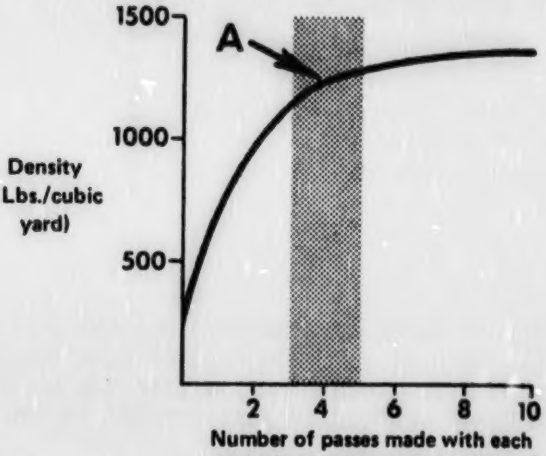


FIGURE 3.3
Compactability of solid waste

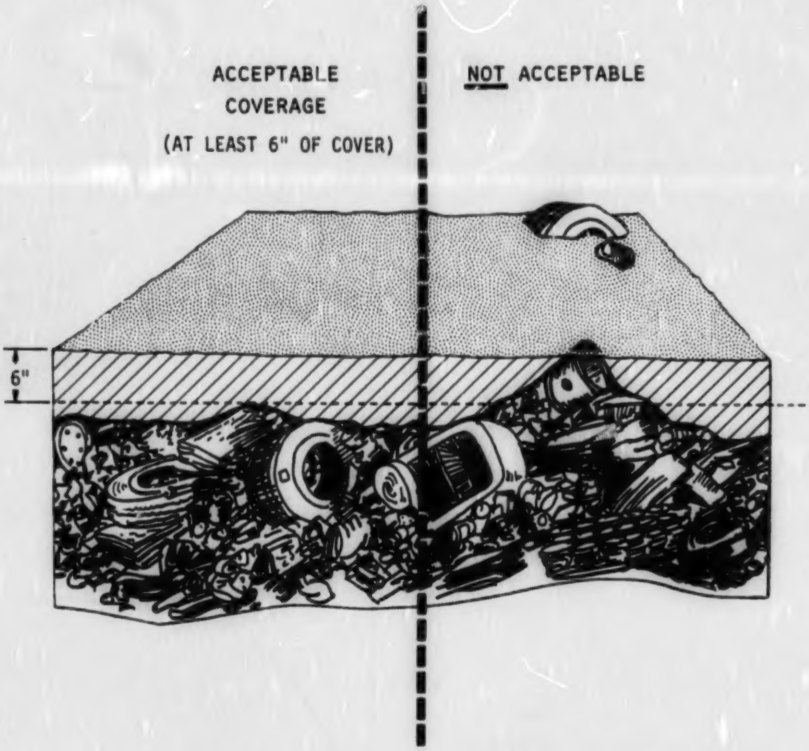


After having compacted that layer of solid waste, another layer of solid waste could be spread and compacted. This would continue through the day until the last load of solid waste is compacted thereby building a cell to the height shown in the plans so it is about as high as the adjacent cells.

At this point, any litter remaining around the site so would be collected and returned to the operating face and daily covering would be started.

Daily cover must cover all the waste with at least six (6) inches of dirt. This does not mean an average of six inches of dirt over the face but enough so that there is at least six (6) inches of dirt over all the waste as shown in Figure 3.4.

FIGURE 3.4
Proper daily cover for solid waste



Any surfaces not to be covered with another cell within one week must have at least one (1) foot of cover instead of just six (6) inches. If that surface will not be covered with another cell within two months, it must have at least two (2) feet of cover instead of just six (6) inches or one (1) foot.

Soils to Use for Cover

You must not use sandy or gravely soils for cover because they will not control flies or keep water from soaking into the waste. Use sands and gravels someplace else - around your building, on your roads or just waste it somewhere away from the solid waste. But do not use it to cover the solid waste.

Likewise, soils with a lot of organic matter will not compact well enough to control flies or keep water away from the solid waste when applied in layers of six inches or a foot. In addition, this topsoil will be needed for plant growth when the site is completed. Therefore, you should stockpile this type soil to be used later as final cover.

Table 3.1 shows some of the advantages of different types of soils.

TABLE 3.1

Suitability of General Soil Types as Cover Material*

Function	Clean gravel	Clayey-silty gravel	Clean sand	Clayey-silty sand	Silt	Clay
Prevent rodents from burrowing or tunneling	G	F-G	G	P	P	P
Keep flies from emerging	P	F	P	G	G	E†
Minimize moisture entering fill	P	F-G	P	G-E	G-E	E†
Minimize landfill gas venting through cover	P	F-G	P	G-E	G-E	E†
Provide pleasing appearance and control blowing paper	E	E	E	E	E	E
Grow vegetation	P	G	P-F	E	G-E	F-G
Be permeable for venting decomposition gas‡	E	P	G	P	P	P

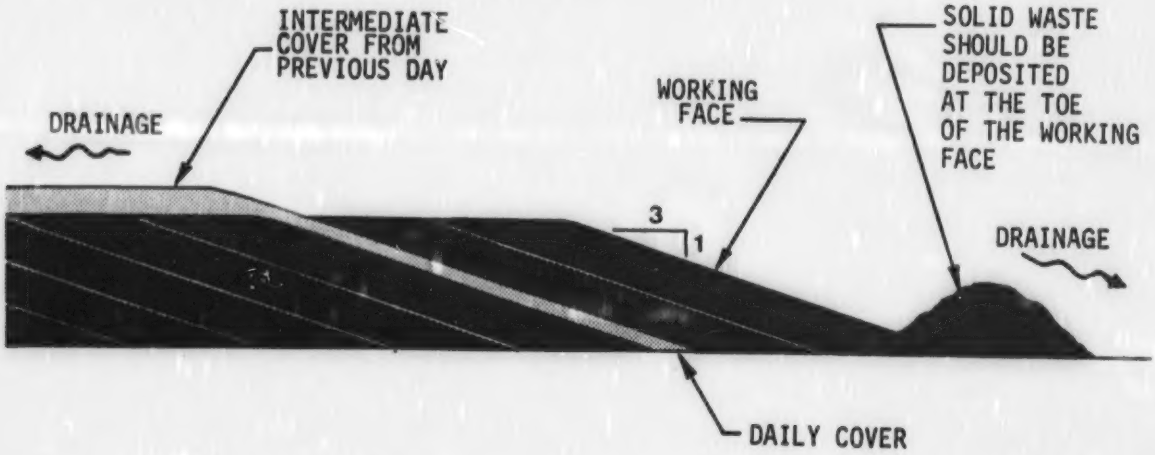
* E, excellent; G, good; F, fair; P, poor.
† Except when cracks extend through the entire cover.
‡ Only if well drained.

Handling Solid Waste at the Working Face

There are a number of ways to make your job easier and make the site last longer. One of the best ways to simplify operations is to make certain that all the solid waste is deposited at the toe (not the top) of the working face as shown in Figure 3.5. This has several advantages:

1. It is easier to compact the solid waste because the first pass over, as you spread the solid waste, does a better job of compaction;
2. The waste is a more sheltered from the wind so you get less litter;
3. It is easier to control where people dump so they are less likely to unload away from the working face and you do not have to push it to the working face.

FIGURE 3.5
Cross section of a daily cell showing deposition of solid waste at the toe of the working face


INTERMEDIATE COVER FROM PREVIOUS DAY
DRAINAGE
WORKING FACE
SOLID WASTE SHOULD BE DEPOSITED AT THE TOE OF THE WORKING FACE
3
1
DRAINAGE
DAILY COVER

Drainage Around the Working Face

A second way of making the job easier is to make certain that rain-water always has a way to drain away from the face. It does not help if you have to pull a car or pickup out. In all likelihood, they will probably leave their next load of garbage at your front gate and malign you for a month. A wet operating area also slows you down. Equipment slips and mud and solid waste get clogged up in your tracks. Because this reduces the chopping action of the tread, grousers or feet, you must make more passes over the solid waste to compact it properly. Naturally the faster the water drains away the faster things dry out. If you can save one day of working in mud it will be worth it.

Conserving the Site

The main ways of extending the useful life of your site are:

1. minimizing the space occupied by the solid waste;
2. properly using all available cover material properly; and,
3. using as little cover material as necessary to properly cover a given days solid waste.

The only way you have available to minimize the amount of space a given amount of solid waste will occupy is to compact it as tighly as you can. To do this you need to use the best equipment available to compact thin layers of solid waste on about a 3 to 1 slope by driving over all of it at least three to five times.

At most sites the engineer has designed the site to make best use of the cover material. In these cases your task is to make certain that you don't lose any cover by burying it or cutting off access to it. Many sanitary landfills were designed to get a ratio of solid waste to cover of 4:1 (four times as much solid waste as cover) but some of the smaller sites can only get a 2:1 ratio. It is very important to get as good a ratio as called for in the plans or you will probably run out of cover material before you get the site filled.

Normally, the biggest use of cover material is daily cover. You must get a compacted layer of six inches of cover over all the waste. However, if the solid waste has been well compacted so that the working face is relatively smooth and firm you won't have to put down 12", 18" or more cover to get a six inch cover over the protruding wastes. Also, if you control the shape of your daily cell to make it as box shaped as possible, you reduce the surface you have to cover. For example, if you cut the width of your working face in half, in most sites you will also reduce the amount of cover you need by nearly half. Likewise an operating face with 6 to 1 slope will require nearly twice as much cover material as one with a 3 to 1 slope.

Working Face Slope

Earlier it was noted that your working face should have a slope of about 3 horizontal to 1 vertical. There are two reasons for this:

1. you get better compaction; and,
2. you use less cover material.

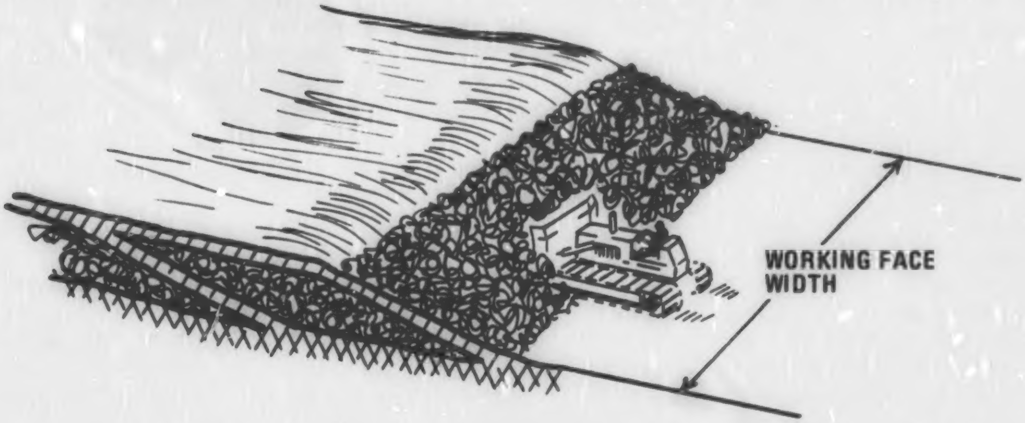
Both of these save you time and effort. In fact, the steeper the slope the less cover it will need but it must be well compacted. As soon as your tracks (or wheels) do slip you fluff up the waste and you've undone your previous compaction so compact it over again. Generally a slope of about 3:1 works the best for tracked vehicles. Certain landfill compactors, however, may not be able to operate on as steep a slope and may need to operate on a slope as shallow as 5:1.

Working Face Width

If you keep your working face as narrow as possible (Figure 3.6) you can significantly reduce the amount of work it takes to run a sanitary landfill. With a narrow working face you:

1. don't need as much cover material;
2. don't have as much exposed waste to blow about as litter; and,
3. don't need to have and move as much portable litter fencing. If you can cut your working face width from 80 feet down to 40 feet you only need half as much cover material to move and compact at the end of each day.

FIGURE 3.6
Keep working face narrow



You do need to consider the amount of traffic you have coming into your site. If people have to wait too long they may just dump their solid waste where they're waiting and leave. So you do want to have a large enough working face to serve your customers.

However, in most operations the width of the daily cell can vary to meet heavy or light days. Also, if many of the vehicles are cars or pickups, a drop box maybe a good idea. This would:

1. allow a narrower face;
2. keep cars out of your way;
3. keep cars out of the packer drivers way;
4. minimize the chance of cars getting stuck;
5. limit the opportunity to scavange in the fill; and,
6. make it as pleasant as possible and hopefully keep everyone a little happier.

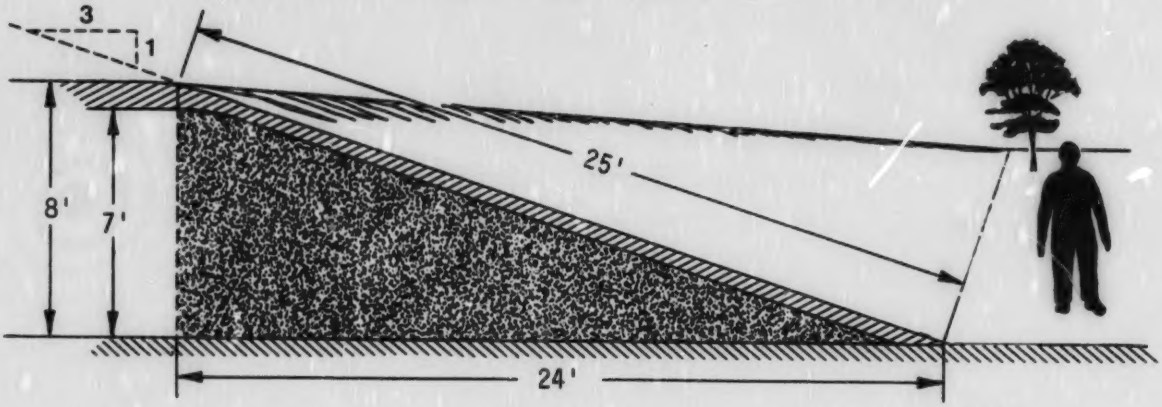
Disadvantages include:

1. having another place to keep clean; and,
2. having to maintain the drop box area to provide access for both the private vehicles and the vehicle removing the solid waste.

Lift Height

Using the proper lift height can reduce the amount of cover necessary. As with limiting the width of the daily cell the purpose of this would be to make the daily cell as box shaped as possible rather than looking like a pancake. There is a limit to how long a working face can be in that you want to have a long enough slope to drive the compaction equipment on. Most sites have been designed with lifts about eight feet high, as shown in Figure 3.7. With a 3 to 1 slope this would result in a working face about 25 feet long (this is 5 to 10 feet longer than a typical crawler with blade or bucket or better than twice the length of the crawler tracks on the ground). However, changing the height of your working face may result in drainage problems or in having to use more final cover to get the final slopes properly shaped. As a result, before you ever change the height of your working face, you must talk it over with your engineer and have him get approval from the Iowa Department of Environmental Quality through an amendment to your permit.

FIGURE 3.7
Dimensions of a typical working face cross section



CHAPTER 4

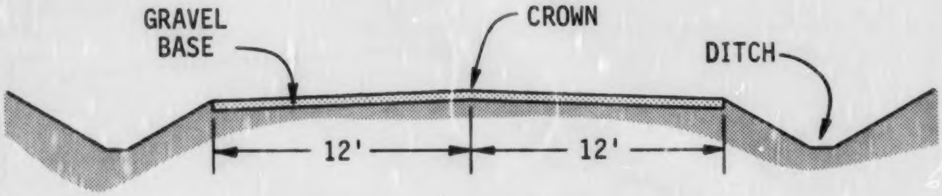
ROADS AND TRAFFIC CONTROL

Roads

An all weather road is required from the gate to the toe of the working face. The roads must be maintained in useable condition for the volume of traffic and size of vehicles that use the sanitary landfill. Usually this means that the roads are well rocked. This sounds expensive, however, when figuring in the cost of maintaining machinery and downtime, it is not.

Roads should be 22 to 24 feet wide for two way traffic and at least 12 feet wide for one way traffic. Grades should not exceed seven percent on uphill grades and ten percent on downhill grades. The roads should also be properly crowned to promote runoff. (See Figure 4.1).

FIGURE 4.1
Cross section of road



Rubble (i.e. stone, brick, concrete) that comes into the sanitary landfill can be worked into the road bed as a base material.

Traffic Control

A spotter at the working face is the best insurance against accidents and the best director for traffic control. He can keep people from wandering from their own vehicles and being injured by sanitary landfill equipment.

If sanitary landfill users are not shown exactly where to unload, they tend to unload where they please. This makes litter control and daily cover difficult.

Good directional signs are necessary for the person who rarely makes a trip to the sanitary landfill. Directional signs along state highways are provided by the Iowa Department of Transportation. Directional signs on the site aid in getting the waste unloaded in the designated area.

CHAPTER 5

INCLEMENT WEATHER OPERATIONS

The Iowa Department of Environmental Quality rules require that solid waste be covered daily and that intermediate and final cover be applied as needed, regardless of weather conditions. Therefore, an operator is confronted with the problem of obtaining cover that can be spread, not only in weather when the ground is frozen but also during prolonged periods of wet weather.

WINTER OPERATION

Cover Material

Stockpiling and insulating earth cover is the approach commonly used in Iowa. The stockpile can be located adjacent to the operating area or in an area that is readily accessible. Stockpiles will have less front penetration along the south side. Therefore, it is a good idea to run them east-west so they have a large southern exposure. A diversion trench or berm should be constructed so surface water from higher elevations will be directed around the stockpile.

The area to be excavated may be scarified and covered with insulating materials for use as a source of winter cover. Densely planted standing crops may be left unharvested so as to collect snow. This can, in most areas, be excavated readily for several days after the crop has been removed.

Insulating materials include straw, cornstalks, saw dust, wood chips or leaves. The latter can be picked up in residential areas using a vacuum pickup powered with a PTO drive tractor or an auxillary engine.

Snow Fences

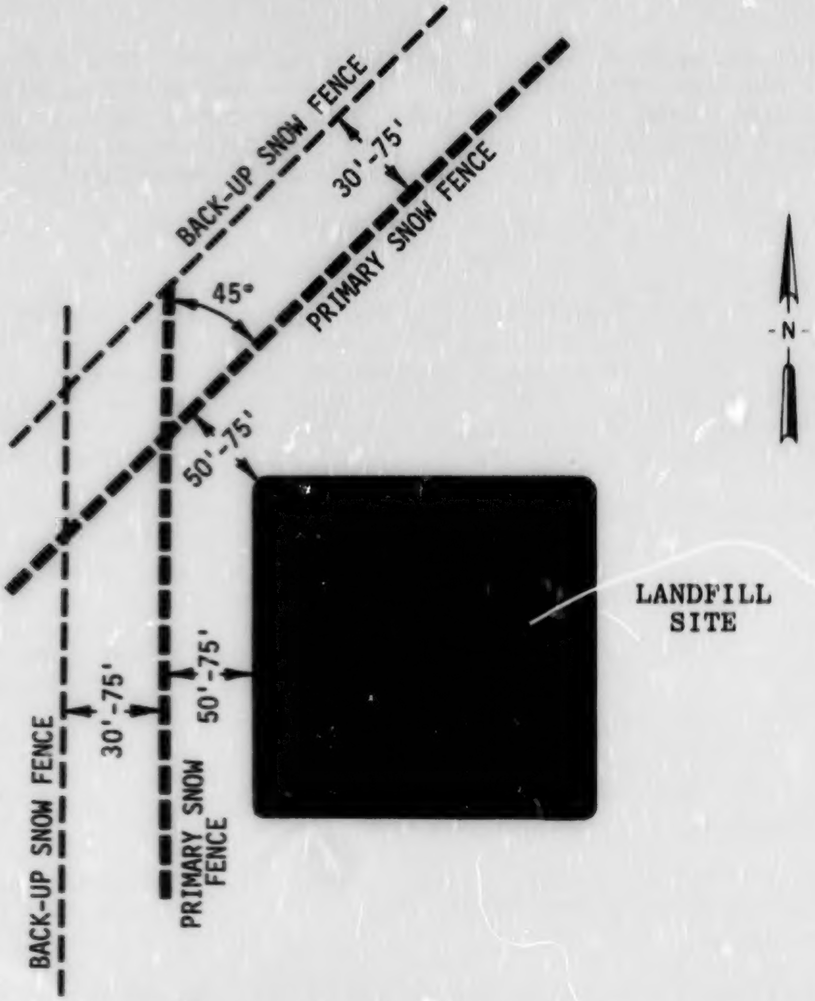
In Iowa, most snow storms come out of either the southwest or the northwest although an occasional storm comes out of the east.

No hard and fast rules can be made regarding snow fence placement; however, states such as Wyoming have made substantial contributions through a process of evaluation and study.

Figure 5.1 shows where snow fences may be placed prior to the commencement of the winter season.

The north-south fence should be placed 50 to 75 feet west of the sanitary landfill site. It shoud extend an equal distance to the north and south of the site. A second fence at a 45^{o} angle should also be extended to the east beyond the site as shown. Backup fences, shown as dotted lines, at a distance of 30' to 75' beyond the first line fences are desirable. A succession of snow falls or extensive drifting will render both fences ineffective, unless there is considerable melting.

FIGURE 5.1
Placement of snow fences to minimize snow removal requirements


BACK-UP SNOW FENCE
30'-75'
PRIMARY SNOW FENCE
45°
50'-75'
N
LANDFILL SITE
BACK-UP SNOW FENCE
30'-75'
PRIMARY SNOW FENCE
50'-75'

Placement of fences for a given site must be done on the basis of trial and error, since manmade and natural obstacles such as trees may alter drift patterns.

Shrubs, trees, stockpiles of earth and building location may also be used to control snow, and in addition, may serve as site barriers.

WET WEATHER OPERATIONS

Precipitation in Iowa fluctuates from less than 20 inches to between 40 and 45 inches per year. Preparation is essential for wet weather, which usually occurs in the late spring and early fall.

Prepratory work includes stockpiling, not only earth cover material but also rubble, rock and suitable waste building materials for use as road materials.

The engineering plan must be reviewed carefully to ensure that all drainageways, dikes and terraces are constructed in strict compliance with the plans. Figure 5.2 shows the placement of a ditch to intercept and divert surface runoff. Terraces or dikes (Figure 5.3) can also be used for this purpose. Permanent diversion ditches or terraces or dikes must be seeded, sodded or riprapped to prevent erosion.

FIGURE 5.2
Placement of ditch to intercept and divert surface runoff

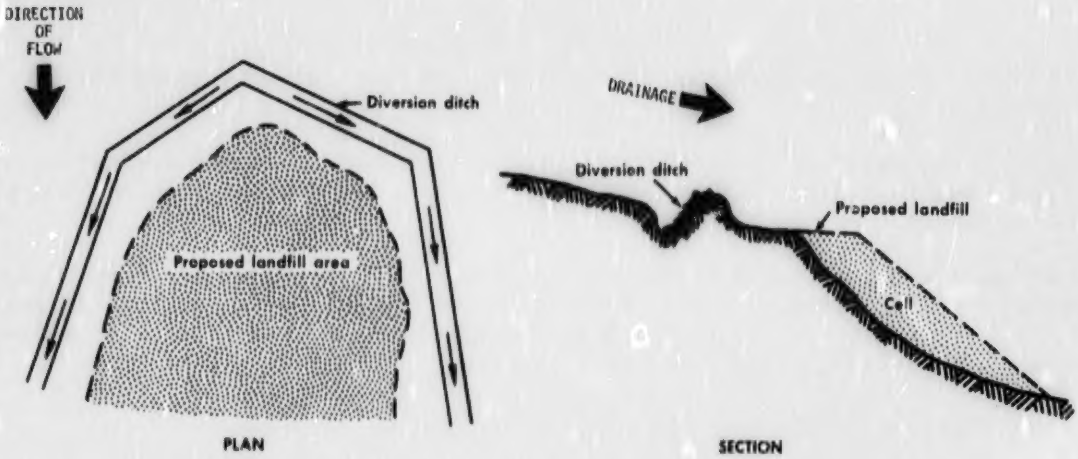
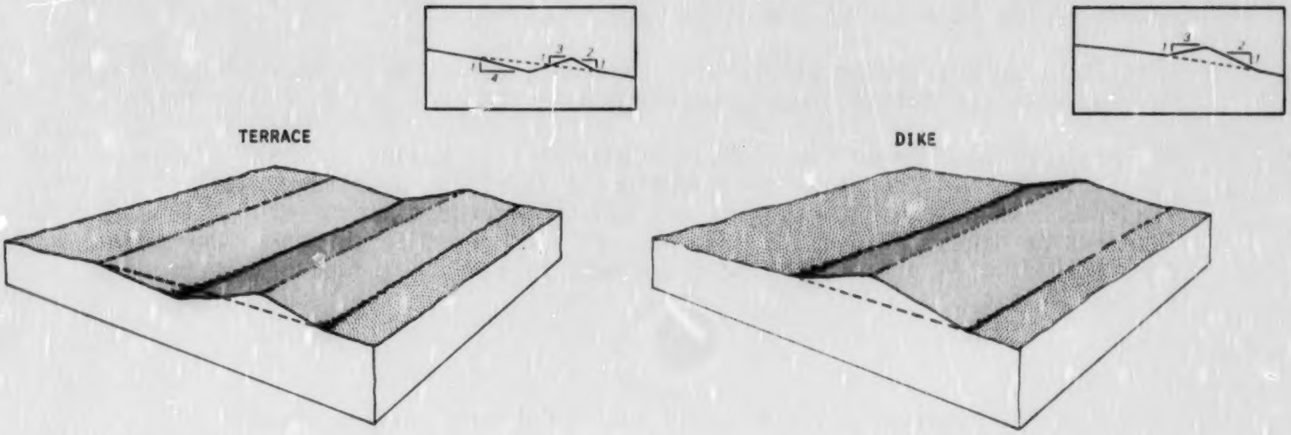

DIRECTION OF FLOW
Diversion ditch
Proposed landfill area
PLAN
DRAINAGE
Diversion ditch
Proposed landfill
Cell
SECTION

FIGURE 5.3
Typical terrace and dike construction



Temporary diversion terraces may be lined with half culverts to control erosion.

Any surface water which accumulates on the site must be either drained or pumped out to ensure that moisture is not permitted to soak into the incoming solid wastes.

Engineering plans should be checked to ensure that any ramps or access roads to wet weather disposal areas of the site are useable during periods of prolonged wet weather. In the absence of special wet weather sites, the access road must be usable in all weather right up to the working face.

CHAPTER 6

VECTOR AND LITTER CONTROL

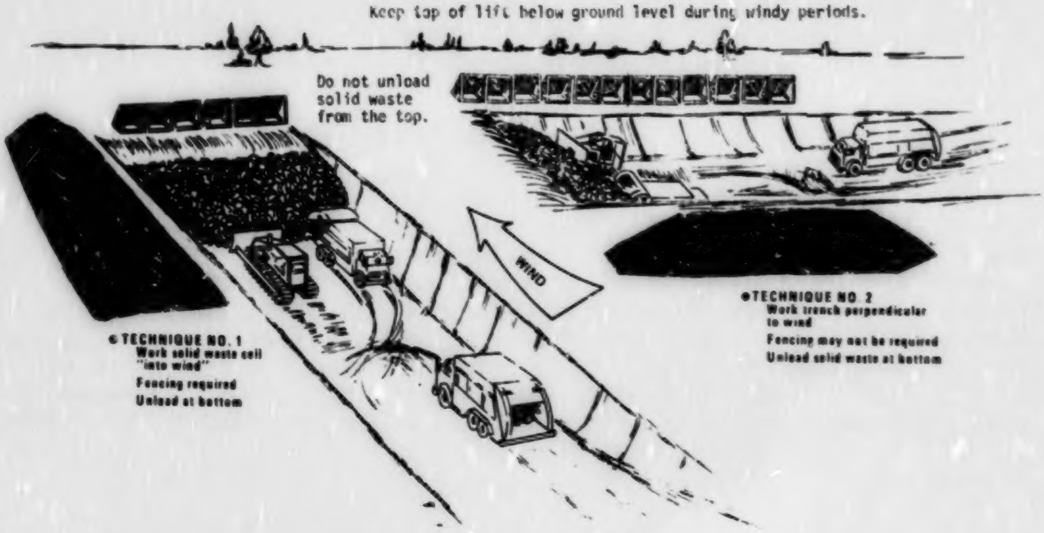
Vector Control

In a properly operated and maintained sanitary landfill, insects and rodents are not a problem. Well-compacted wastes and cover material are the most important factors in achieving vector control. At least six inches of compacted earth cover are required for preventing the emergence of houseflies from the fill. Good compaction of the cover material also discourages rodents from burrowing. Good housekeeping and daily covering of the solid wastes are musts for vector control. If flies, rodents, birds, mosquitoes or other vectors become a problem, you should contact your local health department or a professional exterminator about conducting an adequate control program.

Litter Control

A fundamentally sound approach in controlling litter and blowing paper in a sanitary landfill is to layout trenches in a direction that will permit the operator to work with the wind toward his back, with litter fences placed on top of previous fill in front of the operator (Figure 6.1, Technique #1).

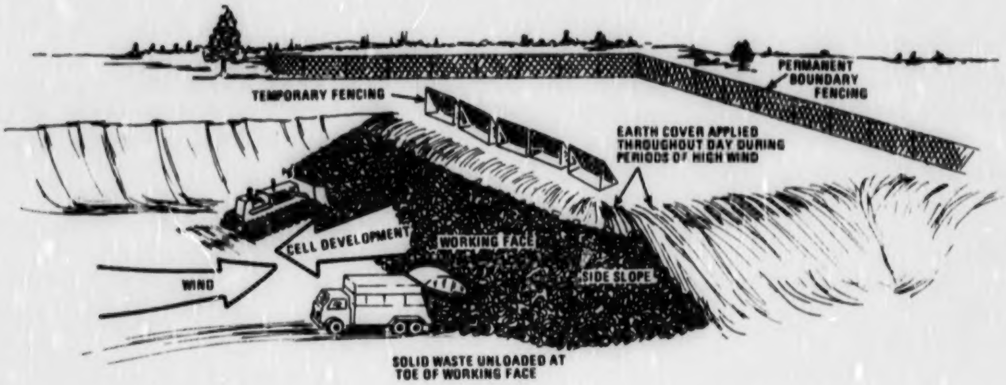
FIGURE 6.1
Locating portable letter fencing at a trench type sanitary landfill


Keep top of lift below ground level during windy periods.
Do not unload solid waste from the top.
WIND
• TECHNIQUE NO. 1
Work solid waste cell "into wind"
Fencing required
Unload at bottom
• TECHNIQUE NO. 2
Work trench perpendicular to wind
Fencing may not be required
Unload solid waste at bottom

As an alternative, trenches may be excavated at right angles to the direction of prevailing winds (Figure 6.1, Technique #2). Placing the cover stockpile material on the upwind side further helps to control litter. In this case litter fencing is placed along the downwind side.

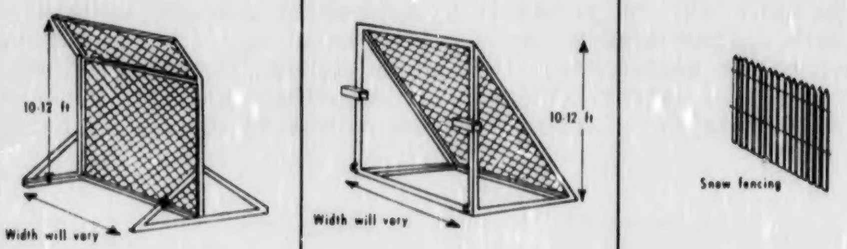
Figures 6.2 show how portable fences can be used at an area type sanitary landfill. It also shows how a portable litter fence can be used in combination with a fixed boundary fence to control litter. A boundary fence similar to the one illustrated at a sixty acre site has been highly effective in controlling litter and confining it to the site.

FIGURE 6.2
Litter fences at an area type sanitary landfill


PERMANENT BOUNDARY FENCING
TEMPORARY FENCING
EARTH COVER APPLIED THROUGHOUT DAY DURING PERIODS OF HIGH WIND
CELL DEVELOPMENT
WORKING FACE
WIND
SIDE SLOPE
SOLID WASTE UNLOADED AT TOE OF WORKING FACE

Three types of portable fences are shown in Figure 6.3. Snow fencing is shown as an example of an unacceptable type of litter fencing. It is recommended that portable litter fencing be 10 to 12 feet high with the fencing material mounted at about a 45 degree angle. The fencing should be no larger than a 4 x 4 inch weave. It is also very important that the frame be made very durable so that it will not be destroyed while being moved. It would not even be out of line if the framing members were 6 to 8 inches in diameter. This recommended design is easy to relocate with a loader by hauling with the bucket in the steel brackets shown. Cable holds can also be provided for use in dragging the fence to the desired area. The third type shown is acceptable if the base, is wide enough to be stable in heavy winds when loaded with litter.

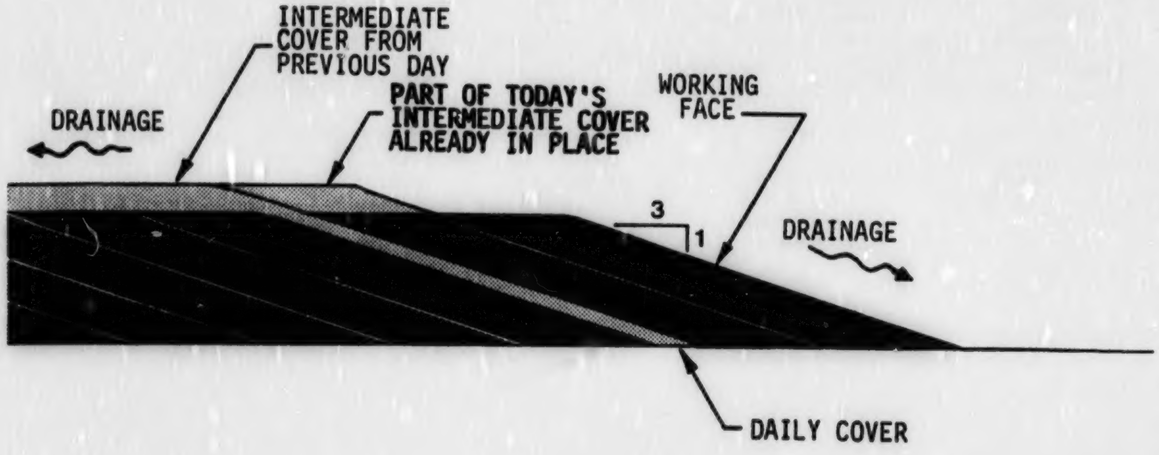
FIGURE 6.3
Various portable litter fence design


10-12 ft
Width will vary
10-12 ft
Width will vary
Snow fencing

ACCEPTABLE	RECOMMENDED DESIGN	NOT ACCEPTABLE
● Framing should be of durable design and construction; brace accordingly ● Screen can be of chicken wire but chain link is preferred	● Inclined design allows better trapping and retention of litter ● Fenced area is more perpendicular to wind direction ● Channel steel on vertical angle-iron is used to carry fence into place ● Cable holds at bottom of vertical angle-iron are used to drag fence into place	

Placing daily cover over completed portions of the daily cell (as shown in Figure 6.4) also controls litter by limiting the amount of solid waste exposed at any one time.

FIGURE 6.4
Early placement of daily cover to control litter

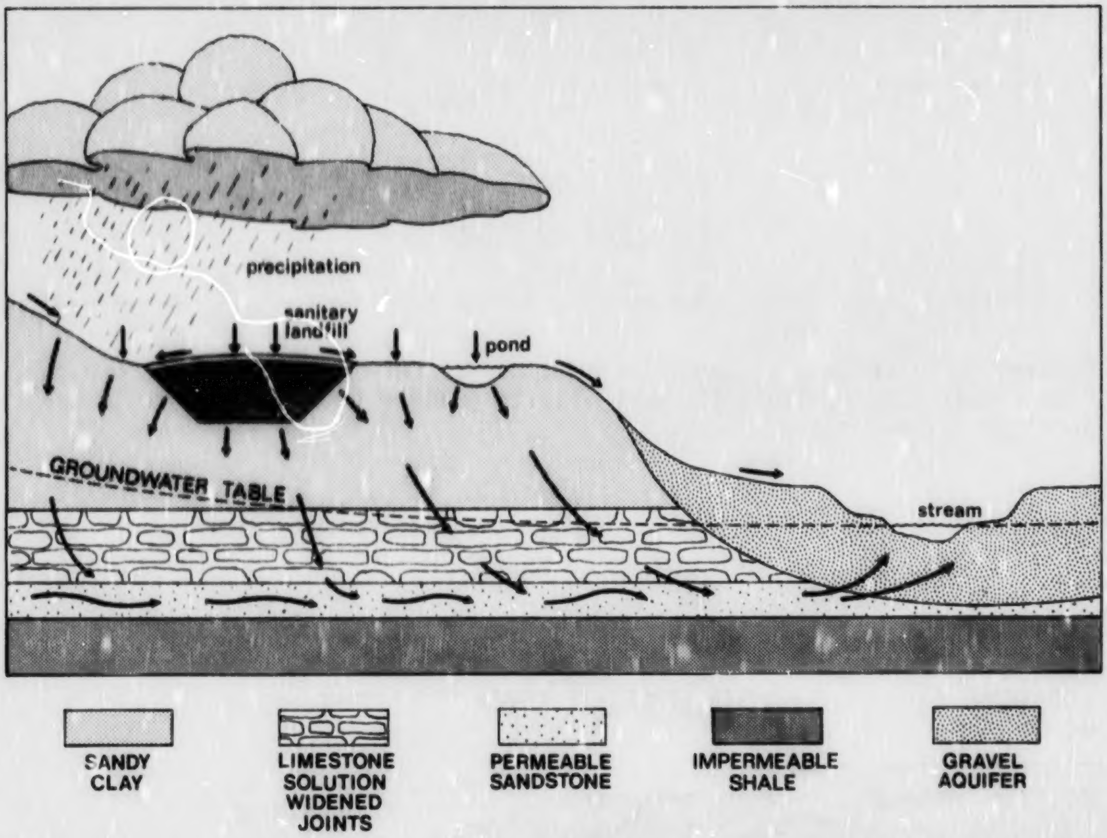

INTERMEDIATE COVER FROM PREVIOUS DAY
DRAINAGE
PART OF TODAY'S INTERMEDIATE COVER ALREADY IN PLACE
WORKING FACE
3
1
DRAINAGE
DAILY COVER

CHAPTER 7

MONITORING FOR LEACHATE

If water gets into solid waste it will accelerate the decomposition of the solid waste. Contaminates will be picked up by this water and carried with it as it seeps out. This contaminated water is called leachate. It could cause a great deal of damage to the environment as it works its way horizontally and vertically into ground or surface waters. Figure 7.1 shows the paths that water follows in carrying this leachate to contaminate ground waters or surface streams.

FIGURE 7.1
Water movement around a sanitary landfill


precipitation
sanitary landfill
pond
GROUNDWATER TABLE
stream
SANDY CLAY
LIMESTONE SOLUTION WIDENED JOINTS
PERMEABLE SANDSTONE
IMPERMEABLE SHALE
GRAVEL AQUIFER

Sanitary landfills are designed to keep water away from the solid waste so it can't get contaminated and to hold in the solid waste any water that does get contaminated. Unfortunately, these designs don't always work. Sometimes the designer makes a mistake, sometimes conditions change and sometimes the operators mess things up. To check for any leachate that may have escaped into the ground water, the Department of Environmental Quality sometimes requires the installation and testing of special wells (called monitoring wells) or the sampling of surface waters at specific locations (called surface monitoring points) such as at springs, tile line outlets, along creeks or at other locations. The following describes how to test these monitoring wells.

INSTRUCTIONS FOR SAMPLING
MONITORING WELLS
AT SANITARY LANDFILLS

This document describes: options available in selecting equipment; requirements that should be met in selecting a laboratory; supplies needed and procedures to be followed in preserving and transporting collected samples; and step by step procedures to be followed in collecting the sample and documenting its collection.

This document does not address placement or design of monitoring well or analysis of the data which results from the sampling program. If you wish any information on these subjects, please contact the Land Quality Management Division of the Iowa Department of Environmental Quality.

Because the method used to collect samples from monitoring wells at a sanitary landfill can significantly alter the results obtained from the analysis of these samples, the Iowa Department of Environmental Quality suggests that the following procedures be followed in the collection of all monitoring well samples. If for some reason these procedures cannot be followed, the procedure used should be submitted to the Land Quality Management Division of the Iowa Department of Environmental Quality along with the sample analysis.

EQUIPMENT SELECTION

The following types of pumping equipment are acceptable:

1) suction pumps, (Figure 1)
2) submersible pumps, (Figure 2)
3) vacuum lift devices (Figure 3)
4) pressure ejection devices (Figure 4)
5) bailing devices (Figure 5)
6) and air operated pumps (Figure 6).

Because other equipment may be acceptable, please contact the Land Quality Management Division if you have any questions.

Suction lift pumps (Figure 1) are the most common types of pumps in the desired size range. But they will not work when the water table is near 25 feet and some will not work if required to lift the water as little as 10 feet. Therefore, you must be particularly careful that the pump you purchase can lift water the required distance. Various types of suction pumps are available including diaphram, pitcher, centrifical, roller, piston and peristaltic pumps. Of these, peristaltic pumps have a real advantage if very exact analysis of the sample for oils or metals will be conducted because the sample never leaves the sampling tube and cannot pick up oils or metals from the pump. However, unless samples will be analyzed for less than 1 ppm concentrations the peristaltic pump has no real advantage over any of the others. Diaphram and pitcher pumps are easily adaptable to hand pumping as long as they are properly valved. Centrificial, diaphram, roller and peristaltic pumps are available with 12 volt motors. All the suction lift pumps can be set up for various power supplies including hydraulic motors, pto drive, belt drive, and 120 V with small capacity transformer for 12 or 24 volt systems. Because of this there is a great deal of flexibility available if you prefer to develop a system for your particular needs rather than buy a complete outfit. Except for a pitcher pump you will need the pump, motor, 30 to 40 feet of sampling tubing and possibly a shut off valve.

Submersible pumps (Figure 2) can be used for any monitoring well depth likely to be encountered but require 4 inch diameter or larger wells. In addition, their capacity may far exceed your sampling needs particularly for shallower wells. This will mean that special valving will be necessary to control water flow in addition to the piping, wiring and retrieval rope leading to the pump. What is necessary can best be determined by the salesman based on your particular circumstances. Almost all submersible pumps use 120 V current and may draw more than a vehicle battery can supply through a transformer. As a result, a small portable generator may be a necessity. In addition, special precautions must be taken to assure that the surface of the pump isn't contaminated before dropping it into the well. This type of pump can be quite heavy as is the support equipment needed. Therefore, special handling precautions may be necessary. Because of this complexity this method is generally not recommended.

Vacuum lift devices (Figure 3) operate very much like suction lift pumps except that the sample does not travel through the pump at all. Instead the pump is an air pump which produces a vacuum in the sample container thereby drawing the well water up the sample tube into the container. This method has the advantage of minimum contamination of the sample since it touches only the sampling tube and the sample container. Depending on the type of vacuum pump used it may be powered by a small electric motor (12, 24 or 120 V) or by hand. As with suction pumps, this method will not work in wells over 25 feet deep and (depending on the vacuum pump) may not work in considerably shallower wells.

Pressure ejection devices (Figure 4) work by blowing the sample out of the well through a tube that has been inserted to the bottom of the well. This method requires a large volume of compressed gas and a reasonably air tight well but will work at any depth. The pressure the well will be subjected to depends on how deep it is. Therefore, if this method is to be used, the well should be designed for it. Otherwise the casing may be damaged during sampling. In addition to an adequate supply of compressed gas and a sample tube this method requires a special designed well cap and valving to control water flow.

Bailers (Figure 5) are basically just cans on a string. However in order to not aerate a sample, a valve of some sort is necessary to let the water trickle into the bailer. These can be either the simple device shown in Figure 4 or a Kemmerer type sampler with special valving to allow the sample to be taken at any depth below the water level. These involve the least initial cost but require a fair amount of labor to bail out the well prior to sampling. Special care must be taken that the bailer not bind in the casing and pull loose in the well while you're attempting to pull it loose.

FIGURE 1
Use of a suction lift pump in sampling of groundwater from a sanitary landfill monitoring well.

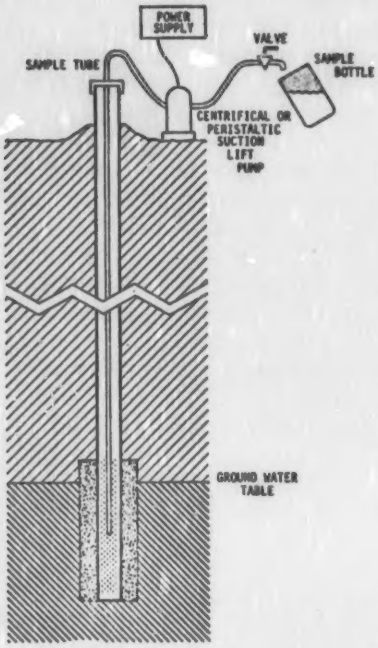

POWER SUPPLY
VALVE
SAMPLE TUBE
SAMPLE BOTTLE
CENTRIFICAL OR PERISTALTIC SUCTION LIFT PUMP
GROUND WATER TABLE

FIGURE 2
Use of a submersible pump in sampling of groundwater from a sanitary landfill monitoring well.

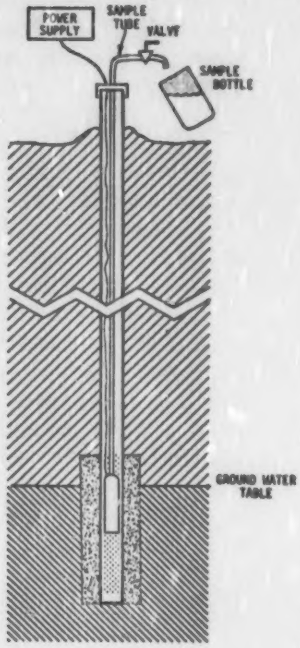

POWER SUPPLY
SAMPLE TUBE
VALVE
SAMPLE BOTTLE
GROUND WATER TABLE

FIGURE 3
Use of a vacuum lift pump in sampling of groundwater from a sanitary landfill monitoring well.

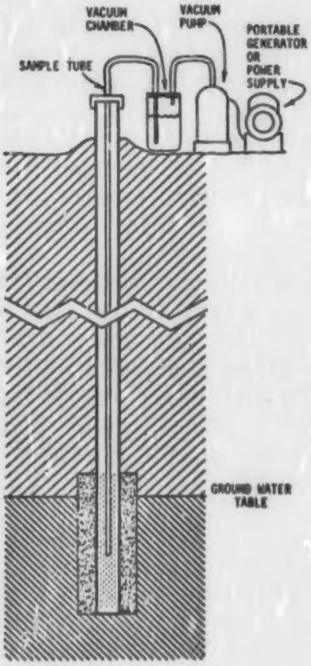

VACUUM CHAMBER
VACUUM PUMP
PORTABLE GENERATOR OR POWER SUPPLY
SAMPLE TUBE
GROUND WATER TABLE

FIGURE 4
Use of pressure ejection in sampling of groundwater from a sanitary landfill monitoring well.

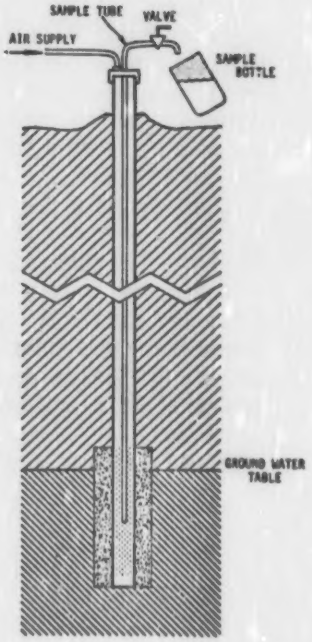

SAMPLE TUBE
VALVE
AIR SUPPLY
SAMPLE BOTTLE
GROUND WATER TABLE

FIGURE 5
Use of a bailer to collect a groundwater sample from a sanitary landfill monitoring well.

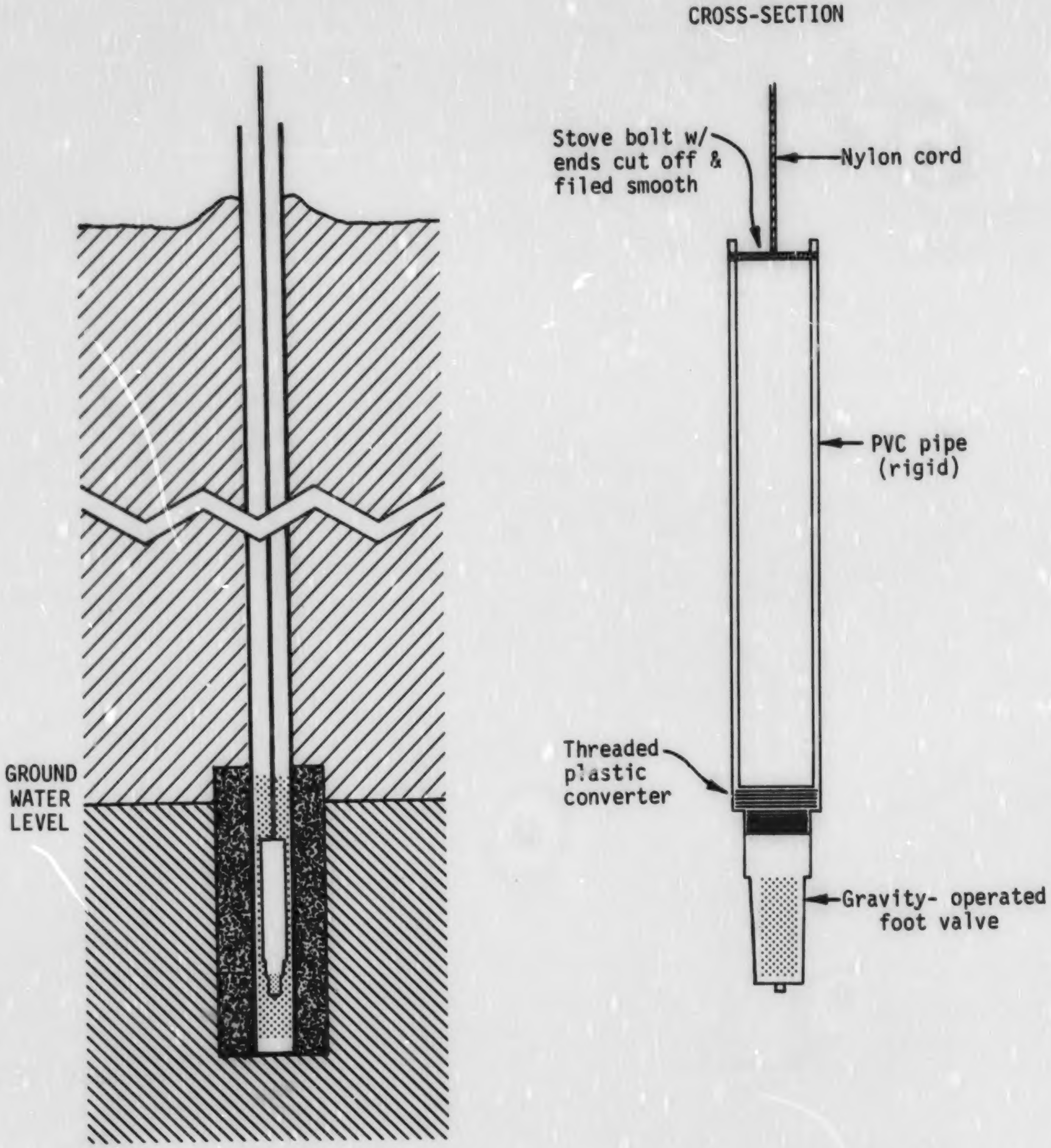
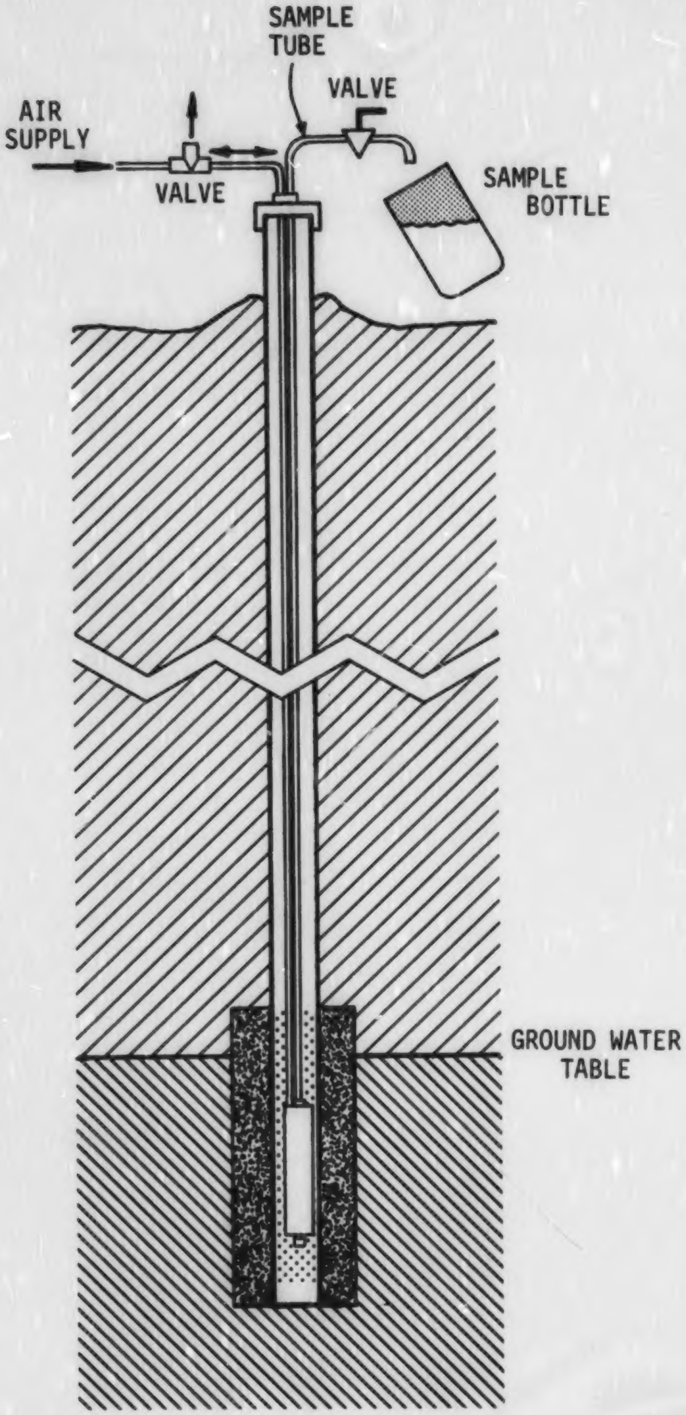
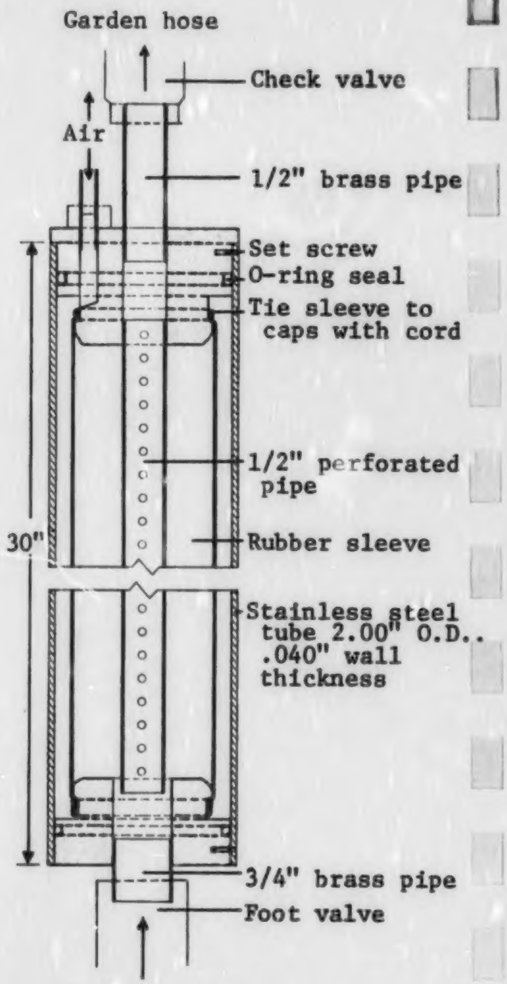

CROSS-SECTION
Stove bolt w/ ends cut off & filed smooth
Nylon cord
PVC pipe (rigid)
Threaded plastic converter
Gravity- operated foot valve
GROUND WATER LEVEL

FIGURE 6
Sample collection by means of air operated pump
from a sanitary landfill monitoring well.

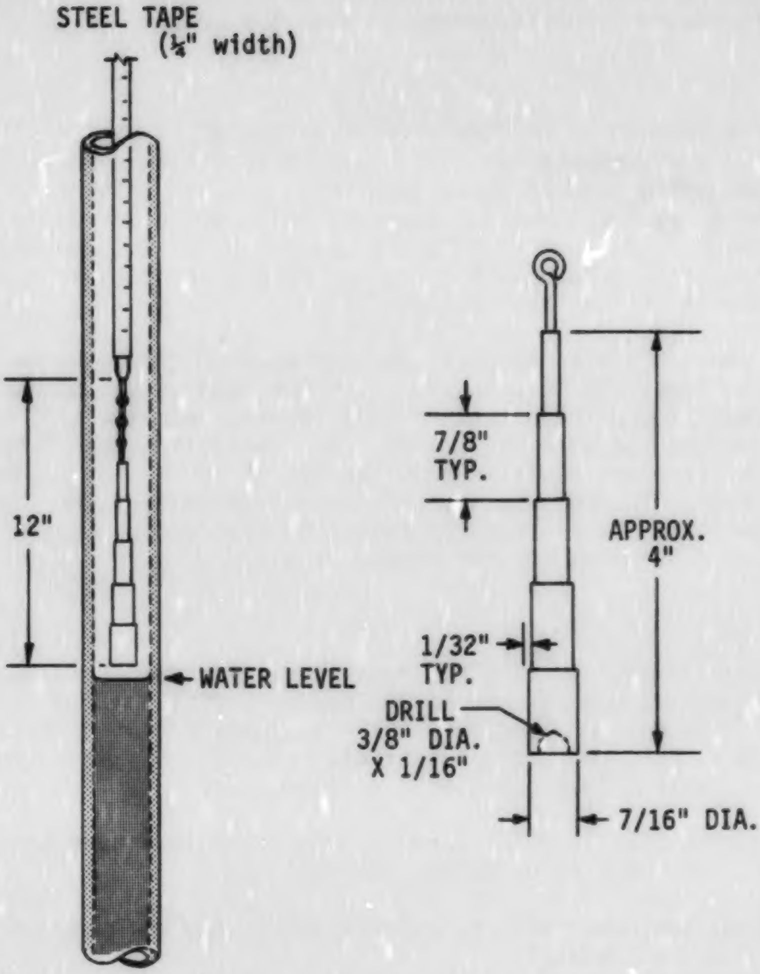

SAMPLE TUBE
VALVE
AIR SUPPLY
VALVE
SAMPLE BOTTLE
GROUND WATER TABLE


Garden hose
Check valve
Air
1/2" brass pipe
Set screw
O-ring seal
Tie sleeve to caps with cord
1/2" perforated pipe
30"
Rubber sleeve
Stainless steel tube 2.00" O.D.. .040" wall thickness
3/4" brass pipe
Foot valve

Not to scale
All fittings are threaded

DESIGN OF THE AIR SQUEEZE PUMP.

FIGURE 7
"Bell sounder" for measurement of water level in a sanitary landfill monitoring well.


STEEL TAPE
(¼" width)
12"
WATER LEVEL
7/8"
TYP.
APPROX.
4"
1/32"
TYP.
DRILL
3/8" DIA.
X 1/16"
7/16" DIA.

Air operated pumps (Figure 6) are really submersible pumps but because they have an uncommon method of operation with some distinct advantages they can be considered as an individual method. Instead of using an electric motor to drive a centrifical pump they use pressurized air to compress a flexible sleeve containing the water to be forced out. They have the advantages of being able to pump from any depth at any flow rate you may desire. In addition, the pump doesn't weigh as much as a conventional submersible pump and can be built to fit smaller diameter well casings. Disadvantages include the need to have a compressed air supply (though less is needed than with pressure ejection); the need to have a valve in the air line to cycle the pump from the compressed air supply to vent to the atmosphere and back to the air supply thereby cycling the pump; the danger of the pump binding up in the well casing as may occur with a bailer; and, the need to take special precautions to assure that the surface of the pump isn't contaminated before dropping it into the well.

MEASURING DEVICES

A measuring tape of some sort is necessary to determine the depth of water in the monitoring well. The simplest way to do this is to attach a "bell sounder" to the end of the measuring tape as shown in Figure 7. With this device you determine the depth to water by lowering the tape until you hear the "plop" that the "bell sounder" makes when it hits the water. By moving the tape in short strokes you can measure the depth quite accurately so long as you remember to add on the length of the "bell sounder".

As an alternative, you can use a weighted tape and measure the distance to the wetted portion of the tape. To do this you lower the tape until your sure it has reached the water, record the amount of tape lowered into the well, raise the tape and record where the tape was wetted. By subtracting this from your first measurement you have the distance from the top of the casing to the water table. To make it easier to spot the edge of the wetted part of the tape you can use chalk on the tape. Other types of measuring devices are available, but whatever works and is convenient for you should be used.

Recommendation

To assure the best quality sample with minimum labor requirements the Iowa Department of Environmental Quality recommends use of a peristalic suction lift pump for wells less than 25 feet deep and pressure ejection devices for wells over 25 feet deep from among the acceptable methods. For measuring the depth to water a tape with a "bell sounder" is recommended.

With any sampling method used, special care must be taken to ensure the sample is not contaminated. In order to do this:

1. All sampling equipment must be cleaned or flushed out between samples at different wells.
2. Proper sample containers and preservation methods must be used.

3. All wastes must be kept away from the well and the well must be kept capped when not in use.
4. Anaerobic conditions must be maintained in the sample by not allowing any air in the sample as would occur if spraying or bubbling occurs. With this in mind, the sample should be trickled down the side of the container at relatively low pressures. This may require special valving for larger capacity pumps.

To ensure a representative sample is taken:

1. The well should be pumped until at least 4 or 5 times the storage capacity of the well has been removed or until it is pumped dry.
2. And, before any sample is taken, the well should be allowed to refill to, or near, its static water level (the level it was at before any pumping was done).

SAMPLES COLLECTION AND PRESERVATION

The sampling program must be planned in advance by contacting a recognized laboratory and arranging for their services. The name of the laboratory selected must be submitted to the Department of Environmental Quality for approval prior to sampling. It is also necessary prior to sampling to obtain the equipment and supplies needed and to decided how the sample will be delivered to the laboratory.

Selecting a Laboratory

The laboratory selected should either be equipped or should be able to provide analytical analysis for metals using the "Atomic Absorption" method, described in the 1974 EPA "Manual of Methods of Chemical Analysis of Water and Wastes" Laboratories shall in all cases strictly adhere to the methodology described in the 1974 EPA "Manual of Methods for Chemical Analysis of Water and Wastes" or "Standard Methods: for Examination of Water and Waste Waters, 14th Edition".

It is suggested that the heading "Laboratories - Testing" in the yellow pages of the telephone directory be used in obtaining the names of acceptable laboratories.

Tests

Background samples are taken only once from each monitoring well - to determine as closely as possible the condition of the groundwater prior to use of the sanitary landfill. Before the background samples can be taken, the monitoring well must be flushed to remove the contaminants introduced by the drilling. After the well recharges, the background sample should be taken as soon as possible.

Background samples must have the following tests performed on them:

Chloride;
specific conductance;
pH;
sulfate;
C.O.D.;
iron; and,
zinc.

Additional tests may be required in your permit or in specific instructions which you have been issued for disposal of potentially toxic or hazardous wastes. Therefore, check these and your permit before you contact your laboratory or take the samples. Also, you engineer may suggest additional tests to address specific concerns which may exist. Therefore, check with him also.

Subsequent ongoing tests should be performed on samples taken at least every six months. These must include the following tests:

Chloride;
specific conductance; and,
pH.

As with the background test, additional tests may be required by the Iowa Department of Environmental Quality or may be recommended by your engineer. Therefore, you should check your permit and any specific instructions you may have received and contact your engineer before you contact the laboratory or take any samples.

Supplies

To hold and preserve the water samples you take you will need:

1) A cooler or similar insulated container;
2) ice, "blue gel" or similar freezer pack;
3) plastic or glass sample bottles;
4) labels

(and for background samples you must also have)

5) preservatives,
6) filter paper (0.45 micron membrane); and
7) a hand vacuum filtering pump, or similar filtering device.

You should have your laboratory supply these items or approve the ones your going to use before you take any samples in order to avoid possible contaminants.

Background Sampling

Most laboratories will supply the proper bottles needed, both regular bottles and "acid fixed" bottles, if they are contacted and informed of the analysis desired. If the laboratory does not supply the proper bottles, the following procedures should be used.

For the background sample you will need at least three (3) bottles:

one of at least 400 ml in size;
one of at least 225 ml in size and
one of at least 50 ml in size.

(To make it easier for the laboratory you may wish to use one quart bottle and two pint bottles.)

All sample bottles should be labeled with the sanitary landfill's name, the Monitoring Well Number, the date and the tests to be performed on the sample.

The contents of the 50 ml bottle would have to be preserved with 2 ml of concentrated sulfuric acid (H_2SO_4) for each 100 ml of sample. This would be tested for COD and the bottle should be so marked.

The contents of the 225 ml bottle would have to be filtered before being placed in the jar and preserved with 2 ml of concentrated nitric acid (HNO_3) for each 100 ml of sample. This would be tested for total soluble iron and zinc and the bottle should be so marked.

The contents of the 400 ml bottle would be tested for chloride, specific conductance, pH, and sulfate and the bottle should be so marked. The filled quart jar then needs only to be placed in the cooler and immediately iced down to 4°C (39°F).

You must get this to the laboratory within 24 hours but it would be much better if you could get it to the laboratory that working day. (Bus or parcel delivery is usually acceptable).

Ongoing Sampling

For the ongoing sampling you will only need one sample regular bottle holding at least 175 ml (about 1 cup).

(To make it easier for the laboratory you may wish to use a pint bottle.) This should be labeled to be tested for chloride, specific conductance and pH in addition to the sanitary landfill's name, the monitoring well number and the date.

This sample need only be placed in the cooler, iced down immediately to 4°C (39°F) and delivered to the laboratory within 24 hours (or that same working day if possible). Bus or parcel deliver service is usually acceptable.

When filling the bottles with the samples, it should be remembered to fill each bottle to the top and avoid over filling the "acid fixed" samples.

WELL DOCUMENTATION PROCEDURES

To properly identify the groundwater being sampled and to provide well details for analysis and documentation the sanitary disposal project "Sanitary Disposal Project Monitoring Well Documentation Form" should be filled out when the well is installed. If the well has already been installed this form should be filled out as best as possible. Copies of this form should be kept at the site, sent to the Land Quality Management Division of the Iowa Department of Environmental Quality and sent to the engineer supervising the site.

1. Note the monitoring well identification number proposed in the plans or assign a number to identify the monitoring well.
2. Prior to drilling identify the purpose of the monitoring well using specific distances and direction where possible.
3. Prior to or during drilling identify the specific strata to be monitored. Examples include: loess-till interface; seams; upper surface of groundwater table; and intermediate portion of till.
4. During drilling note depth at which the strata to be monitored is encountered.
5. During installation of the well note the construction details.
6. Immediately after installation of the well determine the specific location of the well and any measurement or other information not yet noted.

SANITARY DISPOSAL PROJECT
MONITORING WELL
DOCUMENTATION FORM

This form is to be completed when the monitoring well is installed.

Sanitary Disposal Permit No.____

Well No.____________________________Date Installed__________________

Specific Strata to be Monitored______________________________________

____

Depth Below Ground Surface that Monitored Strata Was Encountered__________

____

Purpose of Well:

____ ( ) Monitor water quality before it reaches the sanitary landfill for background purposes.

____ ( ) Monitor leachate quality within the sanitary landfill.

____ ( ) Monitor groundwater quality in the direction of groundwater flow.

____ ( ) Other: Describe:____

Location of Well*:

Give distance and direction of well from a sanitary landfill boundary.

________________________feet in a ________________direction.

Is the location of the monitoring point accurately shown on the site Plans?

________________. Where?____

____

Construction Details*:

Boring diameter (a) ______inches
Casing diameter (b) ______inches
Casing material __________________
Screening length(c)_______________
From Elevation (1)__________(2)______________

Ground Surface Elevation at Well (g)____________

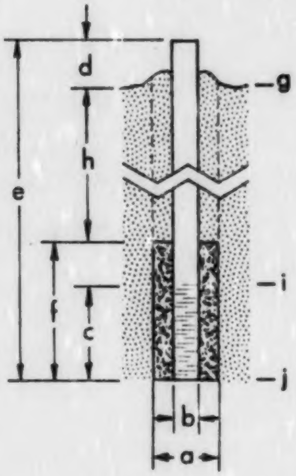
Height of Well Head Above Ground (d)____________

Depth of Well From Head (e)__________________

Backfill:

Type		Depth
____________________	(f)	______________
____________________	(h)	______________

Type of Well Cap____________________________



* Attach copies of portions of the site plans if they more accurately identify location or construction details of monitoring.

SAMPLING SEQUENCE

Help in Collecting and Preserving the Sample

You may want to help in collecting and preserving the sample, especially the first two or three times when you may have unexpected problems with the equipment and supplies. People who may be able to help include:

the County Sanitarian;
the Consulting or Design Engineer;
the County Engineer; and,
personnel from the laboratory which will be doing the testing.

A good understanding of the procedure that must be followed in sampling is necessary to ensure accurate and consistant results. Read through the sequence before you start sampling and make certain all you questions have been answered before you start sampling.

To properly document the collection of the sample and to assure a representative sample, the following procedure should be followed and noted on the "Sanitary Disposal Project Monitoring Well Sampling Form". This form should be completed anytime a sample is taken and the laboratory test results should be attached. Copies should be kept at the site, sent the the Land Quality Management Divison of the Iowa Department of Environmental Quality and sent to the engineer supervising the site.

Prior to Sampling (at Office)

1. Check equipment to make certain it is all there and works.
2. Make certain necessary arrangements have been made with the laboratory that will be doing the testing and transportation has been arranged.
3. Obtain sample conainers and supplies as noted in the sample collection preservation section.
4. On the "Monitoring Well Sampling Form" note well number and depth from "Monitoring Well Documentation Form".
5. Record type of equipment used in flushing and sampling the well. If pressure ejection is used record the gas used.
6. Coordinate the sampling with the delivery system to be used to get the samples to the laboratory.

Prior to Sampling (at Well)

6. Open monitoring well and record if cap was secure or if there is ponded water around the well and if litter, solid waste or other debris has been deposited near well.

7. Measure depth from the top of the well head casing to water table and record with corresponding date and time.

8. Calculate quantity of water to be flushed from well. (You can use the formula or the graph provided in Figure 8.)

9. Install pumping equipment.

10. Pump well to flush standing water from well making certain to pump the water away from the immediate vicinity of the well.

11. Determine and record about how much water was actually pumped from the well.

12. Measure depth from well head to water in well after pumping and record with corresponding date and time. (This may require removing or dismantling the sampling device.)

13. Note if well was pumped dry.

14. Wait for well to be recharged to or near static water level. (This may require returning at a later date).

15. If sampling equipment is removed while waiting for well to refill - make certain well is properly capped and cap is secure.

16. Flush sampling equipment with distilled water or water from a drinking water supply.

At Time of Sampling

17. Have sample containers and any supplies needed to preserve samples immediately available. (As noted in the Sample Collection Preservation Section.)

18. Lable sample bottles (with sanitary landfill name, date, well number and tests to be performed on the sample).

19. Chalk the weighted measuring tape, lower it into the well and measure the depth of water in the monitoring well.

20. Insert properly flushed sampling equipment.

21. Adjust pumping rate of sampling equipment so as to prevent splashing when filling the sample bottles.

Background Tests	Ongoing Tests
22. Collect the large sample and the COD sample.	22. Collect the sample and go to Step 28.
23. Preserve the COD sample with the proper amount of H_2SO_4. (If "acid fixed" bottles were provided by the laboratory, place the sample in the 50 ml. bottle.)	

24. Fold filter, place in hand vacuum sump and wet down filter with a little of the sample from the large bottle.

25. Pour water from the large bottle slowly through the hand vacuum pump and into the the iron and zinc sample bottle.

26. Preserve the iron and zinc sample with the proper amount of HNO_3. (Again if "acid fixed" bottles are provided by the laboratory - place the sample in the 225 ml. bottle.)

27. Refill the large sample bottle if necessary.

---

28. Place bottles in cooler and ice down.

Prior to Leaving the Area

29. Check that all data required on the form has been recorded.

30. Securely cap well.

31. Flush sampling equipment with distilled water or water from a drinking water supply. (Do not flush any sample containers.)

32. Deliver the sample to the laboratory.

Upon Receiving the Laboratory Results

33. Attach a copy of the laboratory results to a copy of the "Sanitary Disposal Project Monitoring Well Sampling Form" and send both to the Land Quality Management Division of the Iowa Department of Environmental Quality.

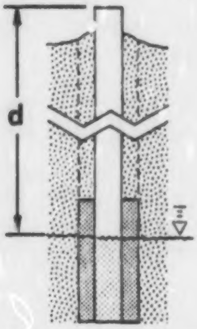
SANITARY DISPOSAL PROJECT
MONITORING WELL
SAMPLING FORM

This form is to be completed as each sample is taken as outlined in the instructions for sampling monitoring wells at a sanitary landfill.

Sanitary Disposal Project Permit Number ______________________

Monitoring Well Number ______________ Data Sample Taken __________________

Sample Number ___________________



WELL CONDITIONS

Was the monitoring well properly capped? Yes_____ No*_____
Was there standing water or litter around the well? Yes*____ No ______
* Discribe below.

WATER TABLE

Water Level In Well	Depth of water(d)	Date	Time
Prior to well flushing			
After well flushing			
Prior to sampling			

WELL FLUSHING

Desirable quantity of water to be pumped from well (Figure 8) ___________________

Quantity of water actually pumped from well. _________________________________

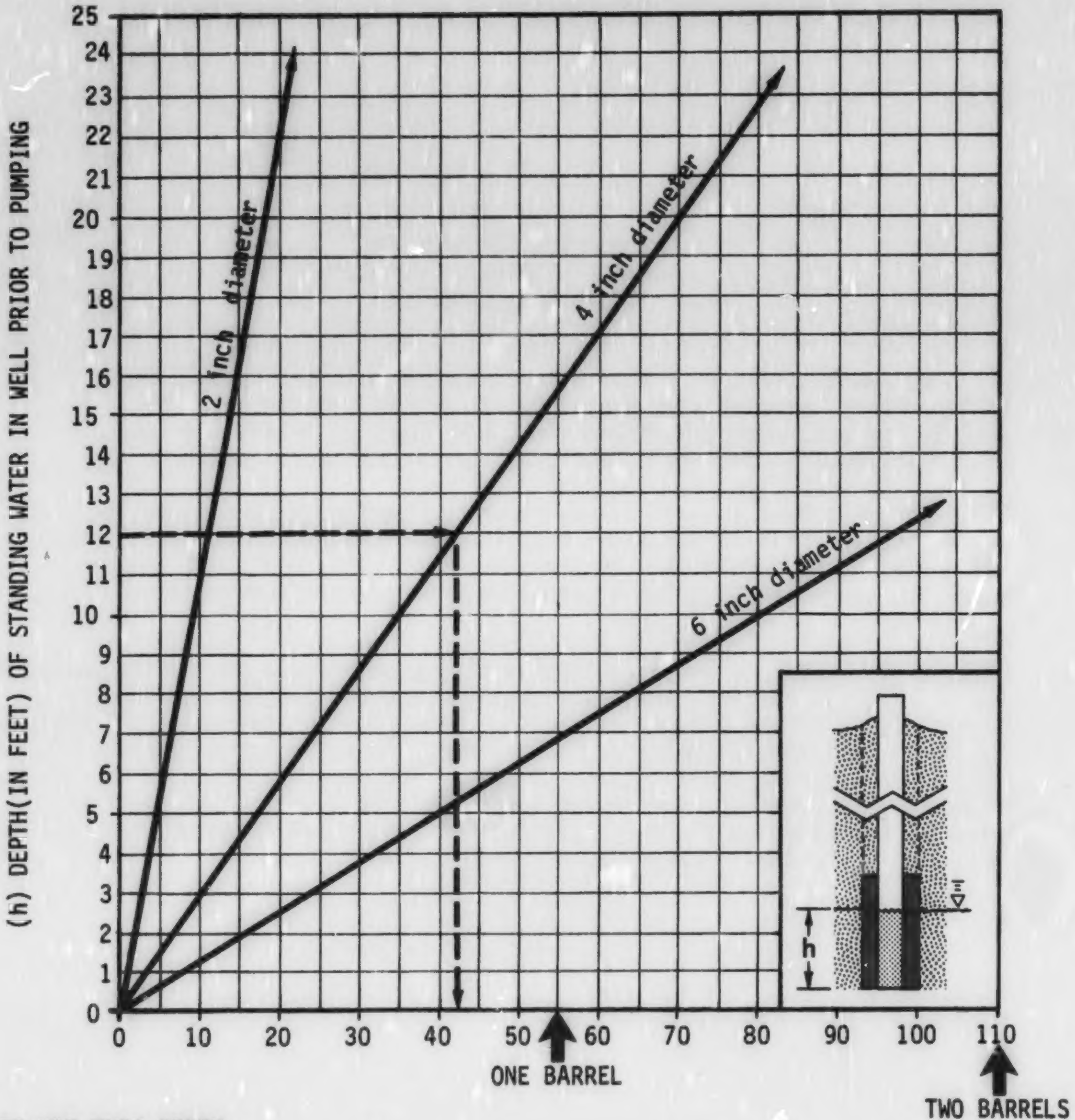
Was monitoring well pumped dry? Yes____ No ____

Equipment used: ____

Comments: ____

NOTE: ATTACH LABORATORY REPORT

FIGURE 8
Approximate number of gallons of water to be pumed from the well.



TO USE THIS GRAPH:

1) Measure depth of water standing in well.
2) Locate the depth along the left side of graph.
3) Mark from there across until you reach the line with the diameter of your well.
4) Mark down from that point to the bottom scale of the graph.
5) Read approximate gallons of water to pump from well from scale.

GALLONS = $0.221\, d^2 h$, where d = well diameter in inches
h = depth(in feet) of standing water in the well prior to pumping

INSTRUCTION FOR SAMPLING
SURFACE MONITORING POINTS
AT SANITARY LANDFILL

This document discusses: The criteria that should be met in selecting a laboratory, step by step procedures to be followed in collecting the sample and documenting its collection, and supplies needed and procedures to be followed in preserving and transporting collected samples.

This document does not address placement or design of surface monitoring points or analysis of the data which results from the sampling program. If you wish any information on these subjects, please contact the Land Quality Management Division of the Iowa Department of Environmental Quality.

Because the method used to collect samples from surface monitoring points at a sanitary landfill can significantly alter the results obtained from the analysis of these samples, the Iowa Department of Environmental Quality suggests that the following procedures be followed in the collection of all surface monitoring points samples. If for some reason these procedures cannot be followed, the procedure used should be submitted to the Land Quality Management Division of the Iowa Department of Environmental Quality along with the sample analysis.

SAMPLES COLLECTION AND PRESERVATION

The sampling program must be planned in advance by contacting a laboratory and arranging for their services. The name of the laboratory selected must be submitted to Department of Environmental Quality (DEQ) for approval prior to sampling. It is also necessary prior to sampling to obtain the equipment and supplies needed and to decide how the sample will be delivered to the laboratory.

Selecting a Laboratory

The laboratory selected should either be equipped or should be able to provide analytical analysis for metals using the "Atomic Absorption" method, described in the 1974 EPA "Manual of Methods of Chemical Analysis of Water and Wastes". Laboratories shall in all cases strictly adhere to the methodology described in the 1974 EPA "Manual of Methods for Chemical Analysis of Water and Wastes" or "Standard Methods: for Examination of Water and Waste Waters, 14th Edition".

It is suggested that the heading "Laboratories - Testing" in the yellow pages of the telephone director be used in obtaining the names of acceptable laboratories.

Testing

Background Tests:

Background samples are taken only one from each surface monitoring point to determine as closely as possible the condition of the groundwater prior to use of the sanitary landfill.

Background samples must have the following tests performed on them:

Chloride;
specific conductance;
pH;
sulfate;
C.O.D.;
Iron and
Zinc.

Additional tests may be required in your permit or in specific instructions which you have been issued for disposal of potentially toxic or hazardous wastes. Therefore, check these and your permit before you contact your laboratory or take samples. Also, your engineer may suggest additional tests to address specific concerns which may exist. Therefore, check with him also.

Ongoing Tests:

Ongoing samples should be taken at least every six months. These must have the following tests performed on them:

C.O.D.;
Chloride;
specific conductance; and
pH.

As with the background sample, additional tests may be required by the Iowa Department of Environmental Quality or may be recommended by your engineer. Therefore, you should check your permit and any specific instructions you may have received and contact your engineer before you contact the laboratory or take any samples.

Supplies

To hold and preserve the water samples you take you will need:

1. A cooler or similar insulated container;
2. ice, "blue gel" or similar freezer pack;
3. plastic or glass sample bottles;
4. labels

(and for background samples you must also have)

5. preservatives;
6. filter paper (0.45 micron membrane); and
7. a hand vacuum filtering pump, or similar filtering device.

You should have your laboratory supply these items or approve the ones you're going to use before you take any samples in order to avoid possible contaminants.

Background Sampling

Most laboratories will supply the proper bottles needed, both regular bottles and "acid fixed" bottles, if they are contacted and informed of the analysis desired. If the laboratory does not supply the proper bottles, the following procedures should be used.

For the background sample you will need at least three (3) bottles:

one of at least 400 ml in size;
one of at least 225 ml in size and
one of at least 50 ml in size.

(To make it easier for the laboratory you may wish to use one quart bottle and two pint bottles.)

All sample bottles should be labeled with the sanitary landfill's name, the surface monitoring point number, the date and the tests to be performed on the sample.

The contents of the 50 ml bottle would have to be preserved with 2 ml of concentrated sulfuric acid (H_2SO_4) for each 100 ml sample. This would be tested for COD and should be so marked.

The contents of the 225 ml bottle would have to be filtered before being placed in the jar and preserved with 2 ml of concentrated nitric acid(HNO_3) for each 100 ml of sample. This would be tested for total soluble iron and zinc and should be so marked.

The contents of the 400 ml bottle would be tested for chloride, specific conductance, pH, and sulfate and should be so marked. The filled quart jar then needs only to be placed in the cooler and immediately iced down to 4°C (39°F).

You must get this to the laboratory within 24 hours but it would be much better if you could get it to the laboratory that working day. (Bus or parcel delivery is usually acceptable).

Ongoing Sampling

For the ongoing sampling you will only need two sample bottles:

1. holding at least 175 ml; and
2. one holding at least 50 ml.

(To make it easier for the laboratory you may wish to use two pint bottles.) The contents of the 50 ml bottles would have to be preserved with 2ml of concentrated sulfuric acid (H_2SO_4) for each 100 ml of sample. This sample would be tested for COD and the bottle should be so marked along with the sanitary landfill's name, the surface monitoring point number and the date the sample was taken.

The 175 ml sample bottle should be labeled to be tested for chloride, specific conductance and pH in addition to the sanitary landfill's name, the monitoring point number and the date the sample was taken. The sample should then be place in the cooler iced down immeidately to 4°C (39°F).

The samples should then be delivered to the laboratory within 24 hours (or that same working day if possible). Bus or parcel delivery service is usually acceptable.

When filling the bottles with the samples, it should be remembered to fill each bottle to the top and avoid over filling the "acid fixed" sample.

MONITORING POINT DOCUMENTATION PROCEDURES

Any location where surface water is accessable may be used as a surface monitoring point. This could be a sump, a tile line discharge, a spring, or a creek. This may be constructed (tile line discharge or sump) or natural (along a creek).

Because of the variety of possible surface monitoring points, it is extremely important to locate and describe the surface monitoring point as precisely as possible when filling out the "Sanitary Disposal Project Surface Monitoring Point Documentation Form" (page 7). This form should be completed when the monitoring point is constructed or selected as the case may be. However, even if the surface monitoring point is already in use, the documentation form should still be filled out as completely as possible. Copies of this form should be kept at the site, sent to the Land Quality Management Division of the Iowa Department of Environmental Quality and sent to the Engineer monitoring the site.

In filling out the form you should:

1. Note the monitoring point identification number proposed in the plans or assign a number to identify the monitoring point.

2. Identify the specific feature to be monitored (using specific distances and directions where possible. Examples include: spring on the loess till interface 300 feet southwest corner of fill, creek 100 feet above site, tile line around solid waste, leachate collection system outlet, etc.

3. Identify the purpose of the monitoring point.

4. During selection or installation of the surface monitoring point, note any special features of the area or any construction details using a figure as provided for. Make certain that there is a conveniently located fixed point to measure dimensions from such as a concrete slab, a rod driven into the ground or some other device. Do not use the ground surface near by or the botton of a drainage way.

5. Immediately after installation of the surface monitoring point determine its specific location and any measurement or other information not yet noted.

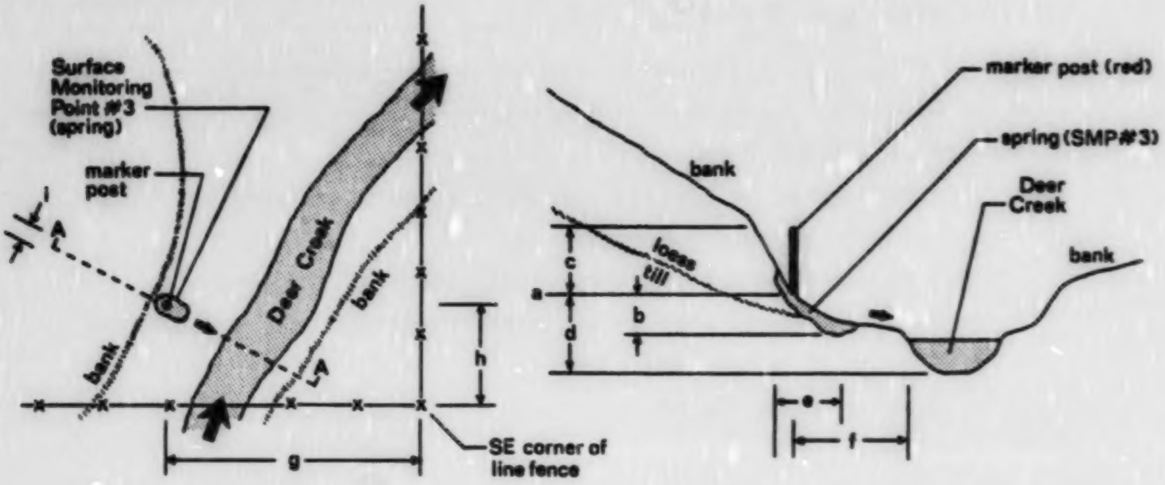
6. Attach copies of portions of the site plan if they help to identify the location or details of the monitoring point.

FIGURE 1
Example of surfacing monitoring point documentation figures

A

Surface Monitoring Point #3
Spring near Deer Creek

Cross section AA


Surface Monitoring Point #3 (spring)
marker post
i
A
A
bank
Deer Creek
bank
h
g
SE corner of line fence
marker post (red)
spring (SMP#3)
Deer Creek
bank
bank
loess
till
c
a
b
d
e
f

a - ground elevation at spring(marker post)

b - depth of pond, if any, at spring

c - height of marker post

d - difference in elevation between creek and spring at post

e - extent of spring towards creek

f - distance from post to creek

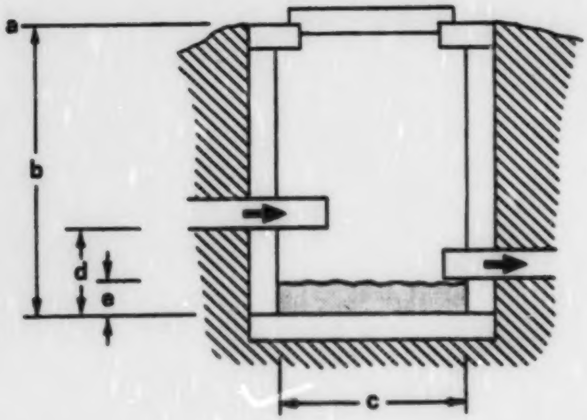
g - distance from east fence to post

h - distance from south fence to post

i - width of spring

B

Monitoring Manhole #2 - Surface Monitoring Point 05.



a - ground elevation at monitoring point

b - depth of manhole

c - diameter of manhole

d - height of inlet tile above base

e - height of outlet tile above base

SANITARY DISPOSAL PROJECT
SURFACE MONITORING POINT
DOCUMENTATION FORM

This form is to be completed when the monitoring point is installed.

Sanitary Disposal Permit No.______________________________

Surface Monitoring Point No.________________ Date Issued______________

Specific area to be Monitored______________________________

____

____

PURPOSE OF MONITORING POINT

____( ) Monitor water quality before it reaches the sanitary landfill for background purposes.

____( ) Monitor leachate quality within the sanitary landfill.

____( ) Monitor quality of water in the direction of (ground/surface) water flow from the site.

____( ) Monitor quality of water being diverted from (under/around) the site.

____( ) Other: Describe:______________________________

LOCATION OF POINT*:

Five specific distance and directions of monitoring point from the sanitary landfill

______________________feet in a ______________direction.

Is the location of the monitoring point accurately shown on the site plan?_____

Where?____

CONSTRUCTION DETAILS*:

Figure of Monitoring Point*

Ground (surface) Elevation at Monitoring Point (a)____________

Depth of bottom of Monitoring Point below ground elevation (b)_______

Other significant Elevations or dimensions.

(c)______________

(d)______________

(e)______________

(f)______________

(g)______________

(h)______________

(i)______________

* Attach copies of portions of the site plans if they more accurately identify location or construction details of monitoring point.

SAMPLING SEQUENCE

With any sampling method used, special care must be taken to ensure the sample is not contaminated. In order to do this:

1. All sampling equipment must be cleaned or flushed out between samples at different surface monitoring points.
2. Proper sample containers and preservation methods must be used.
3. All wastes must be kept away from the monitoring point.
4. If anaerobic conditions exist, they must be maintained in the sample by not allowing any air in the sample as would occur if spraying or bubbling occurs. With this in mind, the sample should be trickled down the side of the container.

Help in collecting and Preserving the Sample

You may want to help in collecting and preserving the sample, especially the first two or three times when you may have unexpected problems with the equipment and supplies. People who may be able to help include:

the County Sanitarian;
the Consulting or Design Engineer;
the County Engineer; and
personnel from the laboratory which will be doing the testing.

A good understanding of the procedure that must be followed in sampling is necessary to ensure accurate and consistant results. Read through the wequence before you start sampling and make certain all your questions have been answered before you start sampling.

To properly document the collection of the sample and to assure a representative sample, the following proceudre should be followed and noted on the "Sanitary Disposal Project Monitoring Point Sampling Form" (page 10). This form should be completed anytime a sample is taken and the laboratory test results should be attached. Copies should be kept at the site, sent to the Land Quality Management Division of the Iowa Department of Environmental Quality and sent to the engineer supervising the site.

Prior to Sampling (at Office)

1. Check equipment to make certain it is all there and works.
2. Make certain necessary arrangements have been made with the laboratory that will be doing the testing and transportation has been arranged.
3. Obtain sample containers and supplies as noted in the sample collection preservation seciton.
4. On the "Monitoring Point Sampling Form" note point number from "Monitoring Point Documentation Form".
5. Coordinate the sampling with the delivery system to be used to get the samples to the Laboratory.

Prior to Sampling (at Monitoring Point)

6. Record if there is ponded water around the monitoring point and if litter, solid waste or other debris has been deposited near monitoring point.

7. Measure depth from the reference point identified on the "Sanitary Disposal Project Monitoring Point Documentation Form" to water and record with corresponding date and time,
8. Note if monitoring point was dry or if there was too little water to collect a sample.
9. If water is flowing, estimate the volume of flow.
10. Note appearance of area including any discoloration. Describe rusty, brown, dark brown, black, etc. and dimensions of discolored area.

At Time of Sampling

11. Have sample containers and any supplies needed to preserve samples immediately available. (As noted in the Sample Colleciton Preservation Section.)
12. Label sample bottles (with sanitary landfill name, date, monitoring point number and tests to be performed on the sample).

Background Tests	Ongoing Tests
13. Collect the large sample and the COD sample.	13. Collect the COD sample
14. Preserve the COD sample with the proper amount of H_2SO_4. (If "acid fixed" bottles were provided by the laboratory, place the sample in the 50 ml. bottle.)	14. Preserve the COD sample with the proper amount of H_2SO_4. (If "acid fixed" bottles were provided by the laboratory, place the sample in the 50 ml. bottle).
15. Fold filter, place in hand vacuum pump and wet down filter with a little of the sample from the large bottle.	15. Collect large sample
16. Pour water from the large bottle slowly through the hand vacuum pump and into the iron and zinc sample bottle.	16. Go to step 19.
17. Preserve the iron and zinc sample with the proper amount of HNO_3. (Again if "acid fixed" bottles are provided by the laboratory- place the sample in the 225 ml. bottle.)	
18. Refill the large sample bottle if necessary.	

19. Place bottles in cooler and ice down.

Prior to Leaving the Area

20. Check that all data required on the form has been recorded.

21. Flush sampling equipment with distilled water or water from a drinking water supply. (Do not flush any sample containers.)

22. Deliver the sample to the laboratory.

Upon Receiving the Laboratory Results

23. Attach a copy of the laboratory results to a copy of the "Sanitary Disposal Project Monitoring Well Sampling Form" and send both to the Land Quality Management Division of the Iowa Department of Environmental Quality.

SANITARY DISPOSAL PROJECT
SURFACE MONITORING POINT
SAMPLING FORM

This form is to be completed as each sample is taken as outlined in the instructions for sampling a surface monitoring point at a sanitary landfill.

Sanitary Disposal Project Permit No.______________________________

Surface Monitoring Point No __________ Date Sample Taken______________

Sample No.___________________________ Figure of Monitoring Point*

MONITORING POINT CONDITIONS

Was there litter around the monitoring point? Yes___ No___
Describe below.

Was the monitoring point dry?
Yes___ No___

Was there too little water to get sample? Yes___ No___

Was water flowing? Yes___ No___
Estimate how much____________

Was the water discolored? Yes___ No___
Describe color and extent of discoloration below.

Was the ground discolored Yes___ No___
Describe color and extent of discoloration below.

WATER LEVEL	Depth of water (d)*	Date	Time
Water level at Point			

Equipment used:____

____

____

Comments:____

____

____

____

____

____

____

* Make certain dimension "d" is shown on figure.

NOTE: ATTACH LABORATORY REPORT

CHAPTER 8

HAZARDOUS WASTE DISPOSAL PROCEDURE

Subrule 27.14(2) of the Solid Waste Disposal Rules (Appendix B) states:

> "No industrial sludge or toxic and hazardous waste shall be delivered to nor disposed by a sanitary disposal project unless explicit instructions are first obtained from the department."

And subrule 27.14(1) states:

> "Radioactive materials shall not be disposed of in a sanitary disposal project. Luminous timepieces are exempt."

Hazardous wastes may be brought to the sanitary landfill from many sources and will be in solid, semi-solid or liquid state. Some wastes can be recycled through any of several companies that process oils, industrial solvents, and chemical recyclables. Any time the operator receives questionable material, he has to decide--will the solid waste be illegal or endanger myself or the environment if it is included in the sanitary landfill? If there is any question, the Land Quality Management Division of the Department of Environmental Quality can advise you of acceptable action (their phone number is on the inside of the back cover). There is a second emergency number (also on the inside of the back cover) that should be used only after regular working hours. It is not for routine questions.

The response will be as quick as possible so as to avoid improper handling or disposal. However, before disposal instructions will be issued, certain specific information must be obtained and reviewed by the Department of Environmental Quality. This information is requested in letter form from the generator of the waste and includes:

1. Quantity of waste to be disposed of;
2. Specific chemical composition and physical form of the waste;
3. Toxicity or other known hazards;
4. Proposed method of packaging and transportation of the waste:
5. Company's suggested method of handling at the disposal site;
6. Recycle or reuse potential of the waste; and,
7. Previous method of disposal.

Since the information needed may be quite complex, it is best to have the company contact the Land Quality Management Division of the Department of Environmental Quality directly rather than trying to obtain the information yourself.

If it is felt that the waste can be safely handled at the sanitary landfill, explicit instructions for the disposal will be issued. A sample of the instruction form (LQ32) can be found on the next page.

The form lists the disposal site, the waste and volume which can be handled, the generator and hauler of the waste, the time period for which the instructions are valid, and any special instructions which are to be followed at the sanitary landfill. The instruction form is for only one specific waste. A similar waste from another company or a different waste from the same company must have separate instructions.

The time period may indicate one disposal only, disposal for several weeks or months, or continuous disposal with the option of reevaluating the instruction any time problems are discovered. If there are any questions regarding the instructions issued, call.

The sequence of events involving a toxic or hazardous waste would be as follows:

1. A problem waste such as an unknown sludge, powder, liquid or other suspicious waste is seen by the operator;
2. Request the name of the generator from the hauler and inform the hauler you cannot accept the waste until you have proper instructions (Accepting a hazardous waste for disposal without instructions is a violation of the rules.);
3. Contact the company and tell them they should contact the Department of Environmental Quality (or call the Department yourself);
4. I.D.E.Q. will request and review information about the waste;
5. If the sanitary landfill can accept the waste, I.D.E.Q. will send you the handling and disposal instructions on the form on the next page; and,
6. Disposal can take place. The volume, date and location of the disposal(s) must be recorded on the reverse side of the instruction form. In addition, you must mark the location on your copy of the plans.

This rather long procedure is used to insure your safety as an operator and also to protect the environment.

Do not handle a waste if you feel there is any danger. If possible, make the producer keep the waste until you receive instructions even if this means telling the driver of a loaded truck that he cannot unload it.

Use the services of the Iowa Department of Environmental Quality.

Follow the instructions sent by I.D.E.Q. exactly and record the required information accurately.

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY
Land Quality Management Division

Explicit Instructions for the Disposal of Toxic and Hazardous Wastes

Disposal Site: ______________________________

The following instructions apply ONLY to the specific waste described and to the volume and time period specified. This is not an overall approval to accept toxic and hazardous wastes. DEQ must supply explicit instructions for any additional toxic and hazardous waste from the same generator or similar waste from a different generator. Failure to obtain this approval is a violation of Solid Waste Disposal Rule 26.14(2). These instructions in no way obligate the above-named disposal site to accept the described waste. The disposal site has the final decision whether to accept the waste, and does so at its own risk.

This form shall be kept in the office at the sanitary landfill for review by DEQ personnel. Each disposal shall be recorded on the reverse of this form.

Waste and Volume: ______________________________

Generator: ______________________________

Hauler: ______________________________

Time Period: ______________________________

Instructions:

Authorized by: ______________________________ Date: ______________

LQ-32

WASTE ACCEPTED FOR DISPOSAL

DATE	VOLUME	LOCATION

HAZARDOUS WASTE CONTAINERS

Many hazardous waste containers received at the sanitary landfill would be acceptable if empty. Accidents occur because many commercial chemical applicators do not completely drain the containers. Some of these chemicals have low flash points and can be ignited easily. If a container has not been completely emptied and rinsed, the chemicals could splash on a hot muffler when the can is compacted and fire can occur in the sanitary landfill. Also it is possible to set the compacting equipment on fire. This is very dangerous and must be avoided.

Many containers, when set out in the sun, warm up and, if closed, will produce tremendous temperatures and pressure. When the pressure is increased by compaction, the container can rupture or explode blowing chemicals all over the operator or causing a fire.

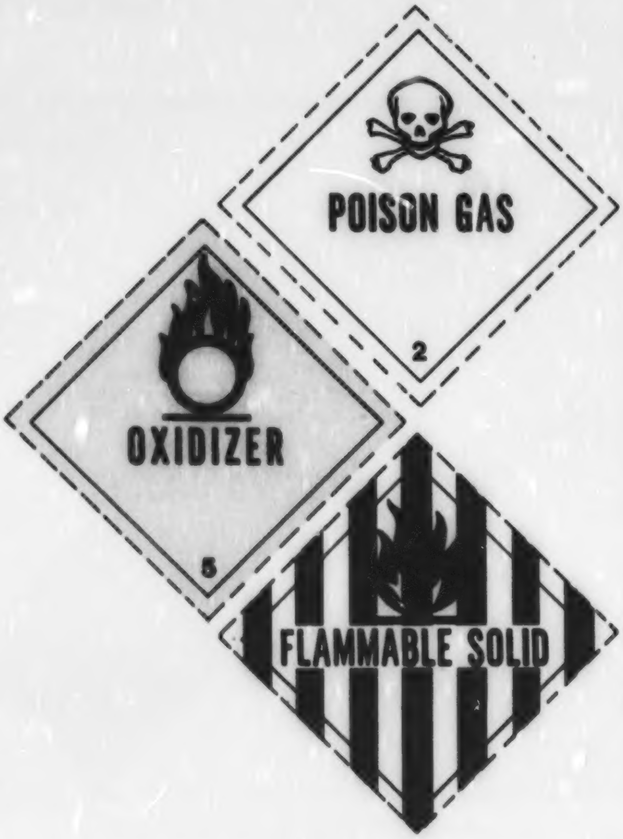
If no explosion or fire results but the operator is exposed to toxic chemicals, there are three ways a chemical can enter his body. It can be swallowed, inhaled or absorbed through the skin.

If you are handling a waste that would cause you to think protective clothing or a respirator was necessary, you should follow the procedure described earlier in this chapter and refuse to take the waste until the Iowa Department of Environmental Quality has issued instructions.

Being aware of lables on containers may give you a clue that you are handling a hazardous waste. The warning label on a container (pail, drum, carton, bag, etc.) may not, however, describe the material that is in the container when it is brought to the sanitary landfill. It does indicate, however, that the company that produced the waste uses hazardous chemicals and would be more likely to produce a hazardous waste. You should be suspicious of any drum of solid, sludge, or liquid material, any bags or boxes of powders or other dry chemicals, or truck loads of powders or sludges whether you see a label or not.

The following is a chart of the presently accepted U.S. Department of Transportation hazardous materials warning labels. You should look at the labels and be aware of their general form.

DOT HAZARDOUS MATERIALS WARNING LABELS


POISON GAS
2
OXIDIZER
5
FLAMMABLE SOLID

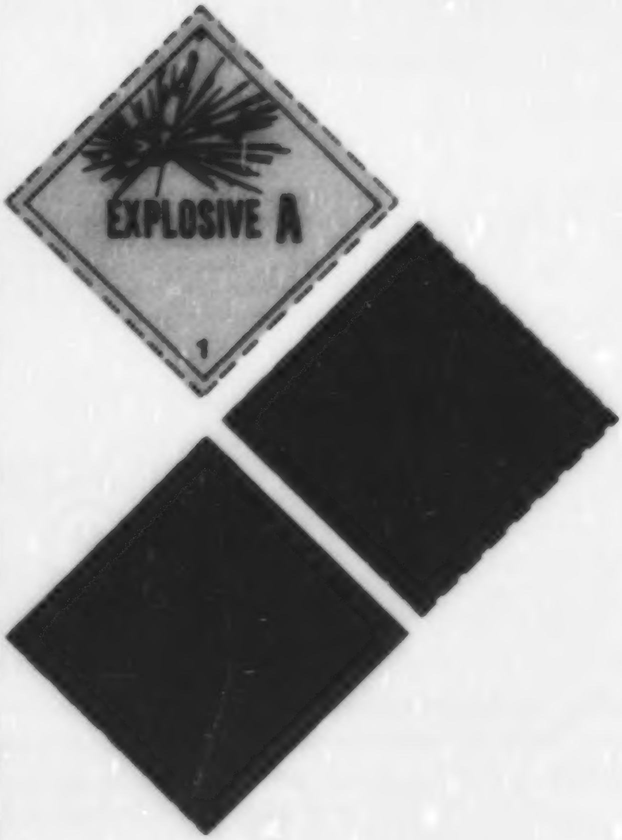

EXPLOSIVE A
1

chart 4

THE DOT HAZARDOUS MATERIALS WARNING LABELS ILLUSTRATED IN THIS CHART, BASED UPON THE UNITED NATIONS LABELING SYSTEM, ARE AUTHORIZED FOR DOMESTIC AND FOREIGN SHIPMENTS AND MEET IMCO AND IATA REQUIREMENTS.

U.S. DEPARTMENT OF TRANSPORTATION
MATERIALS TRANSPORTATION BUREAU
OFFICE OF HAZARDOUS MATERIALS OPERATIONS
Washington, D.C. 20590

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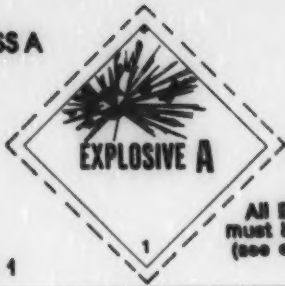
DOT HAZARDOUS MATE

NOTE: General guidelines on use

EXPLOSIVES

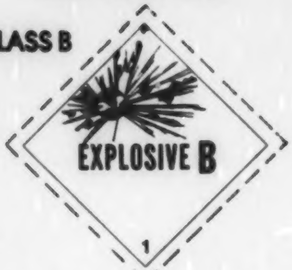
CLASS A


EXPLOSIVE A
1

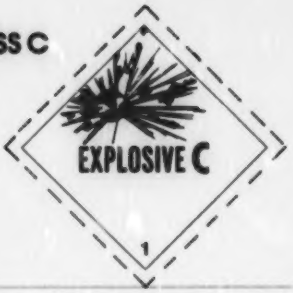
NOTE

All Explosive Labels must be orange in color (see example on cover)

CLASS B

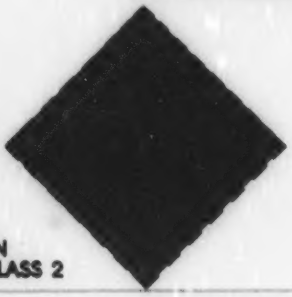

EXPLOSIVE B
1

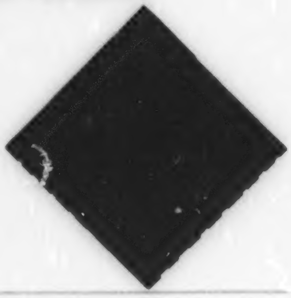
CLASS C


EXPLOSIVE C
1

UN CLASS 1

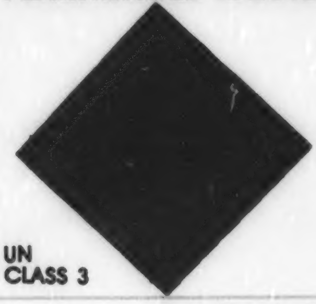
COMPRESSED GASES





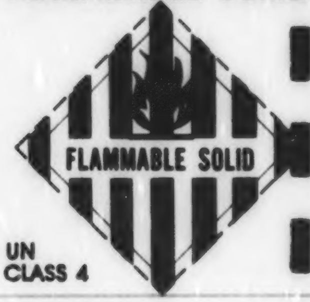
UN CLASS 2

FLAMMABLE LIQUID



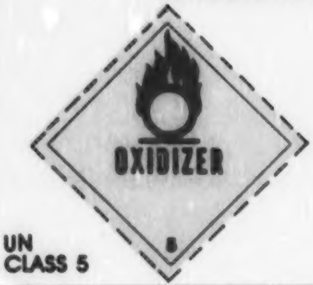
UN CLASS 3

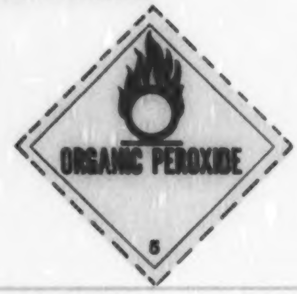
FLAMMABLE SOLI


FLAMMABLE SOLID

UN CLASS 4

OXIDIZING MATERIAL

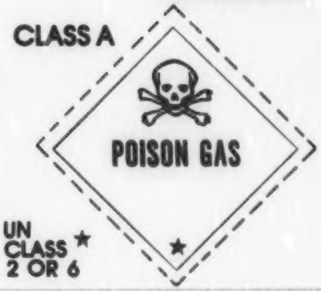



ORGANIC PEROXIDE
5

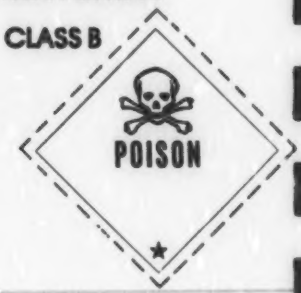
UN CLASS 5

POISONOUS MATERIAL

CLASS A



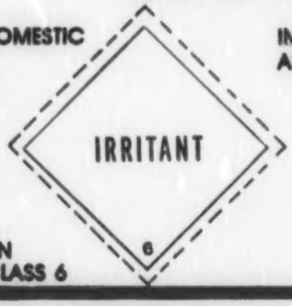
CLASS B



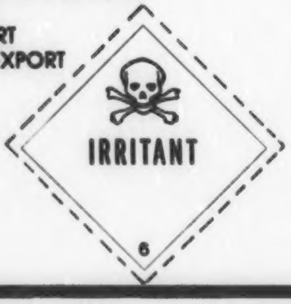
UN CLASS ★ 2 OR 6

IRRITATING MATERIAL

DOMESTIC



IMPORT AND EXPORT

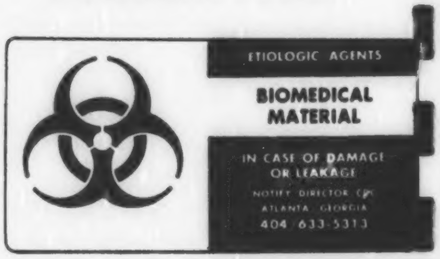


UN CLASS 6

ETIOLOGIC AGENT

Required for domestic shipments including the domestic portion of import and export movements.

Note: A Poison Label may be used on import/export shipments in addition to this label.


ETIOLOGIC AGENTS
BIOMEDICAL MATERIAL
IN CASE OF DAMAGE OR LEAKAGE
NOTIFY DIRECTOR CDC
ATLANTA, GEORGIA
404/633-5313

NOTE: The botton half of the DOT diamond shaped labels may be printed in the language of the country of origin.

LABEL SIZES: Labels shown above are miniatures of the
above must be at least 4 x 4 inches and
each side.
Bung label -- 5 x 3 inches
Etiologic Agent -- 4 x 2 inches

Magnetic Materi

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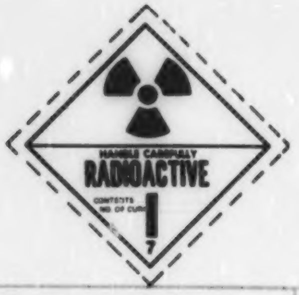
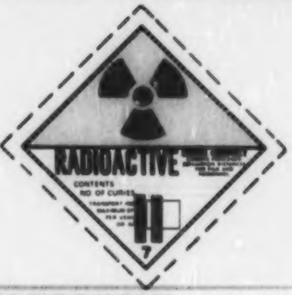
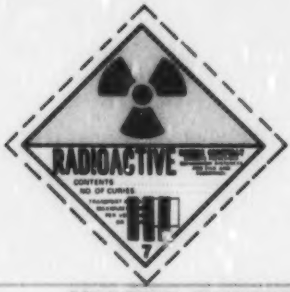
RIALS WARNING LABELS

bels will be found on the back cover.

RADIOACTIVE MATERIALS

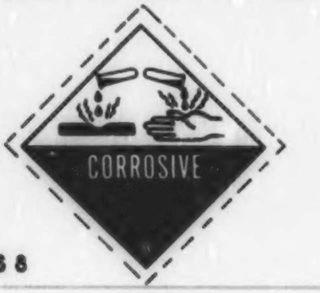

HANDLE CAREFULLY
RADIOACTIVE
CONTENTS
NO. OF CURIES
I
7


RADIOACTIVE
CONTENTS
NO. OF CURIES
II
7


RADIOACTIVE
CONTENTS
NO. OF CURIES
III
7

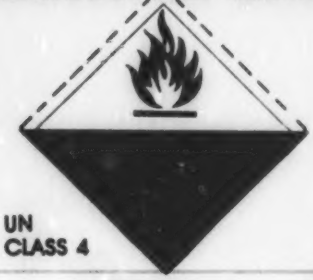
UN
CLASS 7

CORROSIVE MATERIAL



N
LASS 8

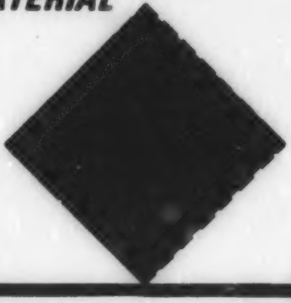
SPONTANEOUSLY COMBUSTIBLE MATERIAL



UN
CLASS 4

NOTE: For use in addition to other required labels.

WATER-REACTIVE MATERIAL



BUNG

CAUTION Unscrew This Bung SLOWLY

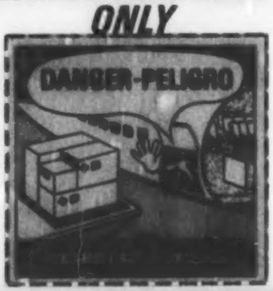
Do not unscrew entirely until all interior pressure has escaped through the loosened threads.

REMOVE BUNG IN OPEN AIR. Keep all open flame lights and fires away. Enclosed Electric Lights are safe.

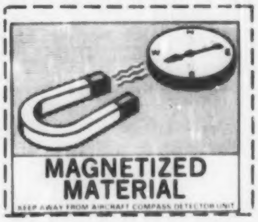
EMPTY

EMPTY

CARGO AIRCRAFT ONLY


DANGER-PELIGRO

MAGNETIC MATERIAL


MAGNETIZED MATERIAL
KEEP AWAY FROM AIRCRAFT COMPASS DETECTOR UNIT

Hazardous materials class numbers are required by some foreign governments. The labels may be overstamped or overprinted with the appropriate hazard class number located in the bottom corner of the label (Ref. Sec. 173.404(g)). Listed below are the hazard classifications and United Nations numerical class designations:

DOT Classifications	United Nations class
Class A explosives	1
Class B explosives	1
Class C explosives	1
Flammable compressed gas	2
Nonflammable compressed gas	2
Flammable liquid	3
Flammable solid	4
Oxidizing material	5
Poisonous gas, Class A	2 or 6
Poisonous liquid, Class A	6
Poisonous liquid or solid, Class B	6
Irritating material	6
Etiologic agent	6
Radioactive materials	7
Corrosive material	8

actual labels. All diamond shaped labels illustrated ve a solid line border at least 3 1/2 inches long on

Empty Label -- 6 x 6 inches (min)
Cargo Aircraft Only -- 4 11/32 x 4 5/16 inches
bel -- 3 9/16 x 4 5/16 inches

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GENERAL GUIDELINES ON USE OF LABELS

1. Shipper must furnish and attach appropriate label(s) to each package of hazardous material offered for shipment unless exempted from labeling requirements. (Ref. Title 49, CFR, Sec. 173.404(a)).

2. If the material in a package has more than one hazard classification, one of which is Class A explosives, Class A poison, or Radioactive Materials, the package must be labeled for each hazard. (Ref. Title 49, CFR, Sec. 173.402(b)).

3. When two or more hazardous materials of different classes are packed within the same packaging or outer enclosure, the outside of the package must be labeled for each material involved. (Ref. Title 49, CFR, Sec. 173.403(a)).

4. Radioactive materials requiring labeling, must be labeled on two opposite sides of the package. (Ref. Title 49, CFR, Sec. 173.402(a) (10)).

5. Labels must not be applied to a package containing only material which is not subject to Parts 170-189 of this subchapter or which is exempted therefrom. However, this paragraph does not prohibit the use of labels required for purposes of import or export shipments or required by 14 CFR 103.13 of the Federal Aviation Regulations on packages destined for transporation by air. (Ref. Title 49, CFR, Sec. 173.404(b)).

6. Labels should be applied to that part of the package bearing consignee's name and address. (Ref. Title 49, CFR, Sec. 173.404(a)).

EXPORT AND IMPORT SHIPMENTS

EXPORT SHIPMENTS -- Exporters are advised that shipments by water or air to foreign destinations may be rejected for transportation if they bear warning labels other than those illustrated in chart, since many countries are implementing labeling requirements conforming to the United Nations Recommendations.

IMPORT SHIPMENTS -- Labels having the same size, color and symbols as prescribed by Title 49 affixed to packages in another country are authorized for shipments in the USA. They may contain inscriptions required by the country of origin. (Ref. Title 49, CFR, Sec. 173.404(f)).

NOTE: The section numbers and references shown above are found in the Code of Federal Regulations, CFR Title 49-Transportation, Parts 100-199 and CFR Title 14-Aeronautics and Space, Parts 60-199. The same references may be found in the following publications which also contain a reprint of Title 49 CFR Parts 100-199:

R.M. Graziano's Tariff (Bureau of Explosives)
ATA (American Trucking Association) Dangerous Articles Tariff

DEPARTMENT OF TRANSPORTATION UNITED STATES OF AMERICA

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REV. NOVEMBER 1975

CHAPTER 9

SEWAGE SLUDGE DISPOSAL IN A SANITARY LANDFILL

Guidelines for the Sanitary Landfill Operator

A safe and environmentally most acceptable way to dispose of dewatered stabilized sewage sludge is to landfill it in a well operated sanitary landfill.

Only stabilized sewage sludge should be accepted at a sanitary landfill. Sludge is stabilized if it has been: 1) digested, either aerobically or anaerobically, 2) treated chemically, 3) heat treated, 4) incinerated, or 5) treated by other thermal processes such as thermal drying and prolysis. Raw sludge and septic tank pumpings shall not be disposed of at a sanitary landfill unless they have been stabilized. Both are health hazards because of their high pathogenic content and when added to solid waste, unstabilized raw sludge generates a stronger leachate than stabilized sewage sludge. (Hereinafter, sewage sludge will mean stabilized sewage sludge.)

Problems to be considered with the disposal of sewage sludge in a sanitary landfill include:

1. Spread of pathogens (bacteria or viruses)
2. Increased leachate production
3. Odor
4. Equipment damage
5. Compaction difficulties.

Unstabilized sewage sludge may contain large numbers of pathogens; therefore, most states prohibit the land disposal of raw untreated sewage sludge because of health hazards to the operator and the groundwater pollution potential. Fungi found in sludge can cause an inflammation of the stomach and intestines and infection of the skin or mucous membranes. An intestinal parasite found in sludge can cause fever, restlessness, and diarrhea. Rapid die-off of the pathogens and reasonable caution in disposal should prevent any health problems.

Sewage sludge disposal in a sanitary landfill is governed by several items; the heavy metals content, ratio of solid waste volume to sludge volume, moisture content, and the degree of treatment.

The heavy metals content dictates whether or not the sludge is a hazardous waste. Sludge from wastewater treatment plants serving highly industralized centers may contain high amounts of heavy metals which would be considered hazardous waste. Heavy metals include zinc, copper, lead, chromium, nickel, and cadmium. An analysis of the sludge will determine whether or not the sludge is toxic.

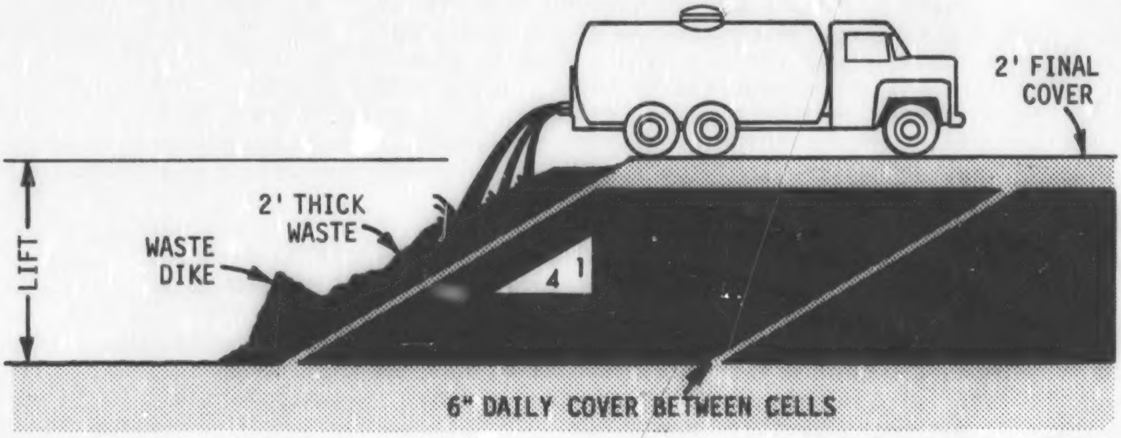
There are three methods of sewage sludge disposal that can be used at a sanitary landfill. These include: 1) mixing the sludge with solid waste and burying, 2) landfilling the sludge in an area separate from the operating area, and 3) land spreading. Each method of disposal requires a different method of operation.

1) Mixing Sludge with Waste

An advantage to adding sludge to solid waste in a sanitary landfill is that the decomposition of solid waste is more complete and rapid because of the additional available nutrients in the sludge. One disadvantage is the additional leachate generated which is dependent on the mositure content of the sludge and the ratio of sludge volume to waste volume.

Sludge that contains too much free water will cause compaction problems at the sanitary landfill. Solid waste dikes must often be constructed at the toe of the lift to insure that the sludge does not run off the face. (See Figure 1.) Sludge addition can result in better fill compaction when the sludge has the proper moisture content.

FIGURE 1
Solid waste and sludge placement



Solid waste has an absorption capacity that can be used to hold the moisture content of sludge. Tests have shown that municipal garbage has an absorption capacity that ranges from 60 to 180 pounds of moisture per 100 pounds of solid waste. These figures were obtained under ideal conditions and would be lower under working conditions. Therefore, the weight of the water in the sludge should not exceed 50% of the weight of the solid waste to which it is applied. Spot mixing requires an even smaller proportion of sludge to solid waste. (See page 8 for sample problem.)

2) Burying Sludge in a Separate Area

If sludge is too wet or there is too much to be properly mixed with the solid waste at a sanitary landfill, it can be landfilled in an area separate from the operating area, but still on the landfill property. A hole can be dug, the sludge unloaded, and cover applied at the end of the day. This method would require a special piece of equipment, such as a clamshell, to get the sludge properly covered at the end of the day.

Unless special equipment is used, sludge buried in an area separate from the operating area should be of a consistency similar to pudding so that it can be worked with typical landfill equipment. This means the sludge should have a moisture content by weight of between 65% to 85%. As adequate experience is gained, maximum workable moisture contents can be established. Until then, all sludges should be dewatered to the extent that is technically and economically feasible. Mechanical dewatering may be required to solidify the sludge.

3) Land Spreading

Sewage sludge should have a solids content greater than 15% when mixed with solid waste. When the solids content is less than 15%, the sludge can be disposed of by land spreading.

The land spreading technique can be divided into two methods. The first is the subsurface method where the sludge is incorporated into the soil by following the disposal vehicle with a disc or plow or by using special equipment to inject the sludge six to eight inches into the soil. Each of the above variations of subsurface disposal gives control over odor. Since flies and birds attracted to a sanitary landfill are the primary carriers of pathogens, the soil cover is also generally adequate protection from direct health hazards.

The second method of land spreading is direct land application of the sludge. Sludge is spread evenly over the ground surface and allowed to dry. After drying, a new layer of sludge can be applied. This last method of disposal is not recommended because of two problems associated with it. Odors can be a nuisance and source of complaints from those using the landfill and neighbors. The second problem is the potential spreading of pathogens by flies and birds.

Procedure for Accepting Sewage Sludge at a Sanitary Landfill

Before sewage sludge is accepted at a sanitary landfill, the operator should:

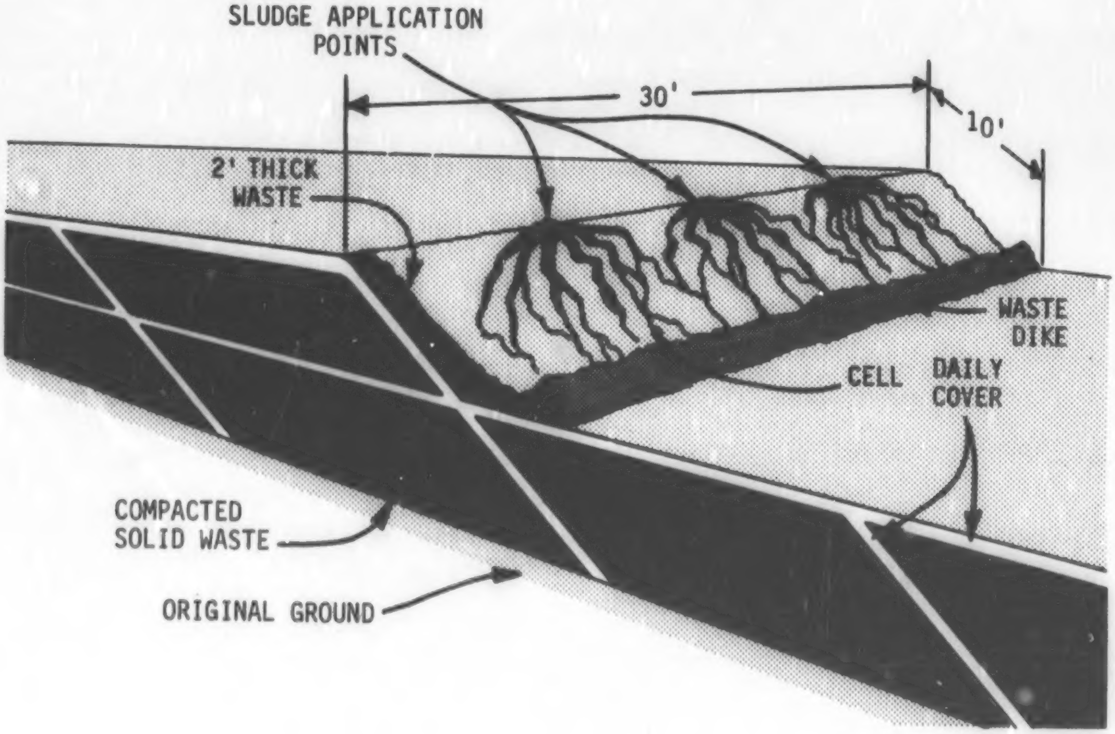
1. Contact the wastewater treatment plant operator to request the following information:
    a. volume of sludge to be delivered to the sanitary landfill and frequency of delivery,
    b. an analysis of the sludge to determine the heavy metal content which shows whether or not the sludge should be handled as a hazardous waste, (a copy should be forwarded to DEQ),
    c. moisture content of the sludge,
    d. a description of the sewage sludge stabilization processes used.
2. Calculate the amount of sludge that can be accepted based on the amount of solid waste that is being landfilled. (Refer to page 6.)
3. Contact the Department of Environmental Quality for guidance.
4. To minimize complaints locate the sludge disposal area at least 200 feet from the nearest residence when land applying sludge.
5. If the sludge is mixed with solid waste the lift should be constructed on a slope of less than 30% with dikes of waste to catch any runoff.
6. Provide an absorptive layer of solid waste prior to the addition of sludge to solid waste.
7. Dispose of sludge with a greater than acceptable moisture content in areas separate from the operating area.

Preparation of a Sludge Disposal Area

Solid waste dumped at either the top or the bottom of the slope should be worked on a slope of 4 to 1 or less to a depth of about two feet. Construct a dike of solid waste at the toe of the lift to catch any runoff. Sludge should be spread evenly across the top of the lift. As new waste is dumped it should be spread over the sludge and compacted. To insure that the sludge is spread evenly, the tank truck may have to move to several application points while unloading.

In order to get the proper amount of waste under and over the sludge, the operator of the sanitary landfill will have to determine the best time of day for sludge delivery.

FIGURE 2


SLUDGE APPLICATION POINTS
30'
10'
2' THICK WASTE
WASTE DIKE
CELL
DAILY COVER
COMPACTED SOLID WASTE
ORIGINAL GROUND

APPROXIMATING THE VOLUME OF LIQUID WASTES THAT CAN BE ACCEPTED AT A SANITARY LANDFILL PER DAY OF OPERATION

Method A

Volume of solid waste over which sludge will be spread = length x width x thickness = ____________ ft. x ____________ ft. x ____________ ft. = ____________ ft^3.

Assume density of compacted waste = 25 lb/ft^3.

Total weight of waste = volume x density = ____________ ft^3 x ______25______ lb/ft^3 = ____________ lb. waste.

The maximum amount of liquid that can be applied per 100 lbs. of waste is 50 lbs. This would be less if the liquid waste was not spread evenly over the solid waste. The operator must decide what amount of sludge he can properly handle.

Total weight of liquid allowed to be spread over solid waste = ____________ lb. waste x ____________ $\frac{\text{lb. moisture}}{\text{lb. waste}}$ = ____________ lb. moisture.

To convert lbs. of water to gallons, divide by 8.34.

$\frac{\text{\_\_\_\_\_\_\_\_\_\_\_\_}}{8.34}$ lb. water = ____________ gallons

No more than ____________ gallons of liquid can be properly handled.

Method B

Multiply moisture content of the liquid waste times the waste volume times 3.6* to get the amount of sludge that can be accepted.

Volume of waste = length x width x thickness of lift = ________ ft. x

__________ft. x __________ ft. = ________________ft^3.

Moisture content (%) x volume of waste (ft^3) x 3.6 =__________ x __________

x 3.6 = _________________gallons.

No more than__________________gallons of liquid can be handled.

---

* $\frac{30}{8.34} = 3.6$

EXAMPLE: A local sewage treatment plant generates 3000 gallons of digested sewage sludge per week and would like to dispose of it at the sanitary landfill. Results of a lab analysis of the sludge show that the heavy metal content is low enough for the sludge to be considered by DEQ to be non-hazardous. The moisture content is 85%. Can the sewage sludge be accepted and properly handled at the sanitary landfill? What should be done by the operator before the sewage sludge is accepted?

1. The moisture content of the sludge is less than or equal to 85%, therefore the sludge may be mixed with solid waste.

2. Approximate the volume of liquid waste that can be handled per day at the sanitary landfill. (Refer to Figure 2 for solid waste dimensions.)

   a) Volume of waste over which sludge will be spread = length x width x thickness = 30 ft. x 10 ft. x 2 ft. = 600 ft^3.

   b) Assume the density of compacted waste = 25 lb/ft^3.

   c) Total weight of waste = volume x density = 600 ft^3 x 25 lb/ft^3 = 15,000 lb.

   d) Assume that the maximum amount of moisture that can be absorbed by the solid waste is 50 lbs. of moisture for every 100 lbs. of solid waste.

   e) Total weight of moisture that can be handled = 15,000 lb. waste x $\frac{\text{50 lb. moisture}}{\text{100 lb. waste}}$ = 7,500 lb. moisture.

   f) To convert lbs. of moisture to gallons, divide by 8.34. $\frac{7{,}500}{8.34}$ lb. moisture = 899 gallons.

   g) Amount of moisture in the sludge = 85% x 3000 gallons = 2550 gallons.

   h) Number of days sludge will have to be delivered = $\frac{2550}{899}$ = 2.8

      Therefore the sludge will be delivered on 3 separate days.

   i) Maximum number of gallons that should be accepted each day $\frac{3000}{3}$ = 1000 gallons.

   j) Summary: 1000 gallons of sludge can be accepted 3 times per week. The sludge must be spread evenly over 300 ft^2. (30 ft. x 10 ft.) of solid waste two feet thick.

3. Contact the responsible sanitary landfill officials and the Department of Environmental Quality for guidance in disposing of the sewage sludge.

4. Determine the best time of day for delivery of the sewage sludge and inform the sewage treatment plant operator of that time. The time will depend on how long it takes to accumulate the required volume of waste, prepare the solid waste to accept the sludge, and accumulate enough waste to cover the sludge disposal area.

5. Construct the lift on a slope of less than 30% with dikes to catch any runoff.

6. Cover the sewage sludge disposal area with incoming solid waste and at the end of the day cover with at least six inches of soil.

CHAPTER 10

SANITARY LANDFILL EQUIPMENT

The types and numbers of equipment required at a sanitary landfill is related to the volume of incoming waste and the operating plan for the site (trench or area fill).

General equipment recommendations proposed by equipment manufacturers and others should be considered only rough nationwide estimates as is Table 10.1 which is reproduced from the U.S. EPA publication Sanitary Landfill Design and Operation. Your particular operating conditions must be considered including the density of the soil to be excavated and the need to excavate layers of frost.

TABLE 10.1
Landfill equipment needs

Solid waste handled (tons/8 hr)	Crawler loader		Crawler dozer		Rubber-tired loader	
	Flywheel horsepower	Weight* (lb)	Flywheel horsepower	Weight* (lb)	Flywheel horsepower	Weight* (lb)
0–20	<70	<20,000	<80	<15,000	<100	<20,000
20–50	70 to 100	20,000 to 25,000	80 to 110	15,000 to 20,000	100 to 120	20,000 to 22,500
50–130	100 to 130	25,000 to 32,500	110 to 130	20,000 to 25,000	120 to 150	22,500 to 27,500
130–250	150 to 190	32,500 to 45,000	150 to 180	30,000 to 35,000	150 to 190	27,500 to 35,000
250–500	combination of machines		250 to 280	47,500 to 52,000	combination of machines	
500–plus	COMBINATION OF MACHINES					

Note: Compiled from assorted promotional material from equipment manufacturers and based on ability of one machine in stated class to spread, compact, and cover within 300 ft of working face.

* Basic weight without bucket, blade, or other accessories.

Because of the heterogenous nature of solid waste, it cannot be compacted readily as soil. For maximum compaction of solid waste, a large heavy machine is desirable.

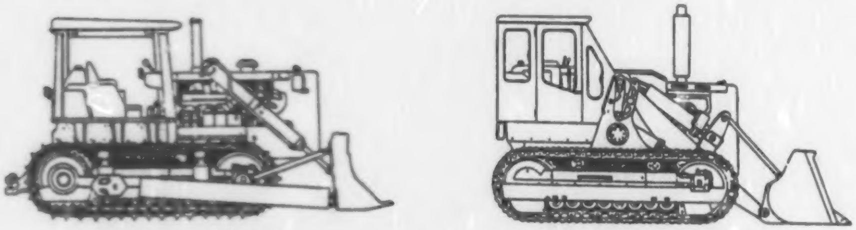
Typical Iowa operations have shown tracked loaders or crawler dozers of about 100 hp and weighing about 25,000 lbs. to be inadequate with a number of sites going to equipment in the 200 hp range with weights of about 40,000 lbs.

Equipment which is too small will require a great deal more maintenance and more operating hours to complete the job along with periodic supplemental equipment to handle adverse weather or heavier waste flows. As a result, most sites using tracked equipment of about 130 hp or 30,000 lbs. also have another or larger piece of equipment at the site at all times to handle these heavier work loads and serve as backup equipment.

Standby equipment must be available within 24 hours for emergencies, breakdowns and whenever equipment is taken out of service for maintenance. A number of agencies have worked out acceptable agreements with cities or counties whereby county equipment can be stored at the site and used as needed with the sanitary landfill paying for whenever they use it.

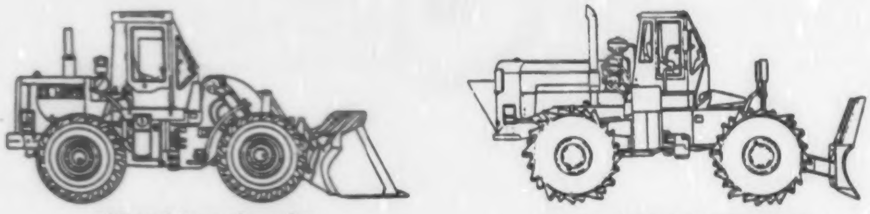
Equipment is available with tracks, rubber tires or steel wheels. (Figure 10.1) Special landfill blades, landfill buckets and multipurpose buckets are available options which are highly recommended.

FIGURE 10.1
Common types of sanitary landfill equipment



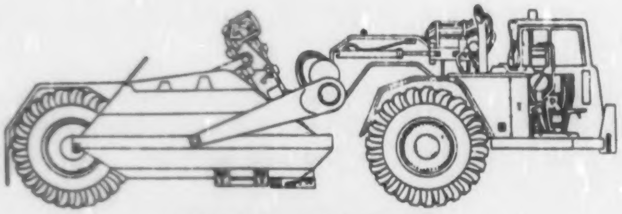
Track-type Tractor

Track-type Loader



Wheel-type Loader

Steel Wheel Compactor



Wheel Tractor-Scraper

EQUIPMENT TYPES AND CHARACTERISTICS

Performance characteristics of landfill equipment is summarized in Table 10.2.

TABLE 10.2
Performance characteristics of landfill equipment*

Equipment	Solid Waste		Cover Material			
	Spreading	Compacting	Excavating	Spreading	Compacting	Hauling
Crawler dozer	E	G	E	E	G	NA
Carwler loader	G	G	E	G	G	NA
Rubber-tired dozer	E	G	F	G	G	NA
Rubber-tired loader	G	G	F	G	G	NA
Landfill compactor	E	E	P	G	E	NA
Scraper	NA	NA	G	E	NA	E
Dragline	NA	NA	E	F	NA	NA

* Basis of evaluation: Easily workable soil and cover material haul distance greater than 1,000 ft.
Rating Key: E, excellent; G, good; F, fair; P, poor; NA, not applicable.

Crawler Type Machines

Crawler type equipment can be obtained with dozer blades or loader buckets. This type of equipment is designed for good flotation and traction. The dozer is a more efficient grader and can move large quantities of solid waste with its larger dozing blade. The loader is an excellent excavator that can compact closer to trench walls and, with available options, is the most versitile equipment available.

Either crawler dozers or tracked loaders can economically move earth distances of up to 300 feet and will serve effectively as primary or backup equipment.

Rubber Tired Machines

Both rubber tired loaders and dozers can be purchased with most of the options available to crawler vehicles though many choose the flexibility of the loader. Rubber tired equipment can travel much faster than crawler type equipment with lower maintenance needs. However they have less traction than a crawler and many have not been designed to operate on a 3 to 1 slope. Therefore, they are not as efficient at excavating material and may require greater drive chain maintenance than expected.

Tires will also wear out quicker due to the corrosive materials found in solid waste and are subject to frequent punctures. Urethane foam fill is available for the tires to eliminate the frequent flat tires.

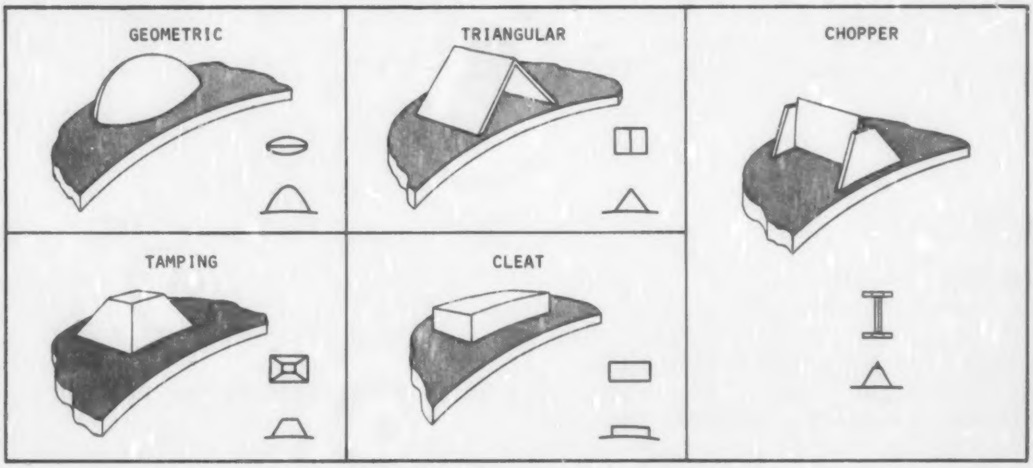
Since wheeled vehicles have less tread touching the ground than tracked vehicles, they should be able to do a better job of compacting. Tests however, have not shown enough of a difference to outweigh good operating procedures.

If you need to haul cover material moderate distances (less than 600 feet) this type of vehicle may serve well for hauling and covering while serving as backup equipment for compaction.

Landfill Compactors

Steel wheeled sanitary landfill compactors have been designed purposely for compacting solid waste. As a result they offer somewhat greater compaction than rubber tired dozers or loaders. The wheels are either hollow steel cores or rubber tires sheathed in steel. Both types are studded with load concentrators (feet) of various design (Figure 10.2).

FIGURE 10.2
Some typical designs of sanitary landfill compactor feet



Landfill compactors are excellent machines for spreading and compacting solid waste. However, they are very poor at excavating and hauling due to their specialized design. Depending on the type of load concentrators landfill compactors may not get enough traction to operate on a normal 3 to 1 operating face. Likewise, different load concentrator designs are more likely to clog with solid wastes and dirt, although some designs have special cleaner bars to prevent clogging. While landfill compactors offer excellent compaction they leave a rough surface which will problably have to be smoothed off with other equipment to provide adequate drainage.

Scrapers

The prime function of scrapers is to excavate, haul and spread cover material. Towed scrapers are being used extensively in Iowa and are economical for haul distances of between 300 and 1000 feet. Self propelled scrapers are suited for hauling earth over distances in excess of 1000 feet. Capacities range from 2 to 50 cubic yards. Some difficulty has been experienced in maintaining haul routes for the larger machines due to their high gross weight.

Draglines

Draglines are suited for excavation in hard soils and in borrow pits and for spreading cover material over compacted solid waste. They are frequently used in large sanitary landfills that use trench type operation.

Special equipment may be needed for such tasks as road construction and maintenance, dust control and fire protection. Some of this may be available on a cost sharing basis or as and where required. Equipment such as motor graders (motor patrols), sheepsfoot rollers and motorized self loading scrapers can be justified for larger sanitary landfills or sanitary landfills with special design features.

ACCESSORIES

A wide range of accessories is available (Table 10.3). The recommended options and accessories can save down time and reduce operating costs by minimizing the chance of overheating (because of clogged radiators), broken fuel and hydraulic lines, tire punctures and damage incurred when waste becomes lodged in the tracks or between the wheels and the machine body.

TABLE 10.3
Recommended and optional accessories for landfill equipment

Accessory	Dozers		Loaders		Landfill
	Crawler	Rubber-Tired	Crawler	Rubber-Tired	compactor
Dozer blade	0[*]	0	—	—	0
U-blade	0	0	—	—	0
Landfill blade	R[†]	R	0	0	R
Hydraulic controls	R	R	R	R	R
Rippers	0	—	0	—	—
Engine screens	R	R	R	R	R
Radiator guards-hinged	R	R	R	R	R
Cab or helmet air conditioning	0	0	0	0	0
Ballast weights	0	0	R	R	R
Multiple-purpose bucket	—	—	R	R	—
General-purpose bucket	—	—	0	0	—
Reversible fan	R	R	R	R	R
Steel-guarded tires	—	R	—	R	—
Life-arm extensions	—	—	0	0	—
Cleaner bars	—	—	—	—	R
Roll bars	R	R	R	R	R
Backing warning system	R	R	R	R	R

[*] O, Optional.
[†] R, Recommended.

In selecting from among the options which are available, the following effects which have special application to sanitary landfill operations should be considered.

General

Counter weights and any other mounted options which add to the equipments weight aid in compaction.

Engine enclosures, radiator guards and reversible or blower radiator fans are almost mandatory in order to keep paper and other light materials from clogging the cooling system.

Armored hydraulic lines greatly reduce the chances of puncture by solid wastes.

Special sanitary landfill blades or buckets can be of great help in moving quanitites of solid waste with minimal blocking of the operator's view.

Multiple purpose buckets for crawler or wheeled front end loaders are very useful for positioning hard to handle wastes and in handling the many diverse jobs required to maintain a sanitary landfill. It can be used to grasp, crush and position hard to handle wastes, load, carry and spread cover material.

Crawler Type Equipment

Track guiding guards should be considered as a way to control side wear on links, sprockets and rollers due to the large amount of turning normally required in sanitary landfill operations. In addition, they may help control clogging of the undercarriage by solid waste.

In choosing the width of track, the narrower shoes are beneficial because they:

increase solid waste compaction;
reduce turning resistance;
reduce uneven loading of undercarriage members; and
reduce tendancy of individual shoes to bend.

They do decrease the flotation of the vehicle which could make it more difficult to obtain cover material in some wet weather situations. However, sites which may have this problem should be maintaining wet weather stockpiles located so as to avoid this problem. If added flotation is needed in compacting solid waste the solid waste is being allowed to pile up too deep and should be compacted in thinner layers.

Single grouser shoes also help increase solid waste compaction, increase traction on wet slippery surfaces, and are less apt to clog up with soil and solid waste. However they do increase turning resistance and stresses on the drive chain. Because of this they may be unavailable or their use may be discouraged by the equipment dealer. In such cases, a double grouser may be acceptable.

Idler position adjustments in the higher setting can reduce turning resistance and shock loads on the drive train caused by single grousers.

Wheeled Equipment

To give rubber-tired machines and landfill compactors more traction and weight, wheels can be ballasted with a calcium chloride solution steel or concrete wheel weights.

Protection against flats can be provided for rubber tired equipment by means of a urethane foam fill which can be injected into the tires.

MAINTENANCE

GENERAL MAINTENANCE

Engine compartments and radiators clogged with dirt or solid wastes will quickly result in overheating and may result in fires. Therefore, it is extemely important that these areas be kept clean through periodic maintenance and frequent inspections.

Bearings clogged with dirt or wound-up with solid waste may fail much faster than normal due to abrasion. Every effort should be made to clean these daily or as they become clogged.

Crawler Maintenance

Worn shoes reduce solid waste compaction thereby requiring more passes over thinner layers of solid waste to get the same compaction.

Uneven sprocket wear and external bushing wear is caused by the great amount of reverse operations.

Sprocket tooth wear will be increased at the tip of the sprocket if dirt or solid waste is allowed to accumulate in the teeth.

Side wear of links, sprockets and roller flanges will result from constant turning in spreading or covering.

Rubber Tired Machine Maintenance

Worn tires are most likely to be punctured and do not compact solid waste as well. This proper compaction requires more passes over thinner layers of solid waste in order to get the same compaction thereby increasing operating costs.

CHAPTER 11

MAP READING

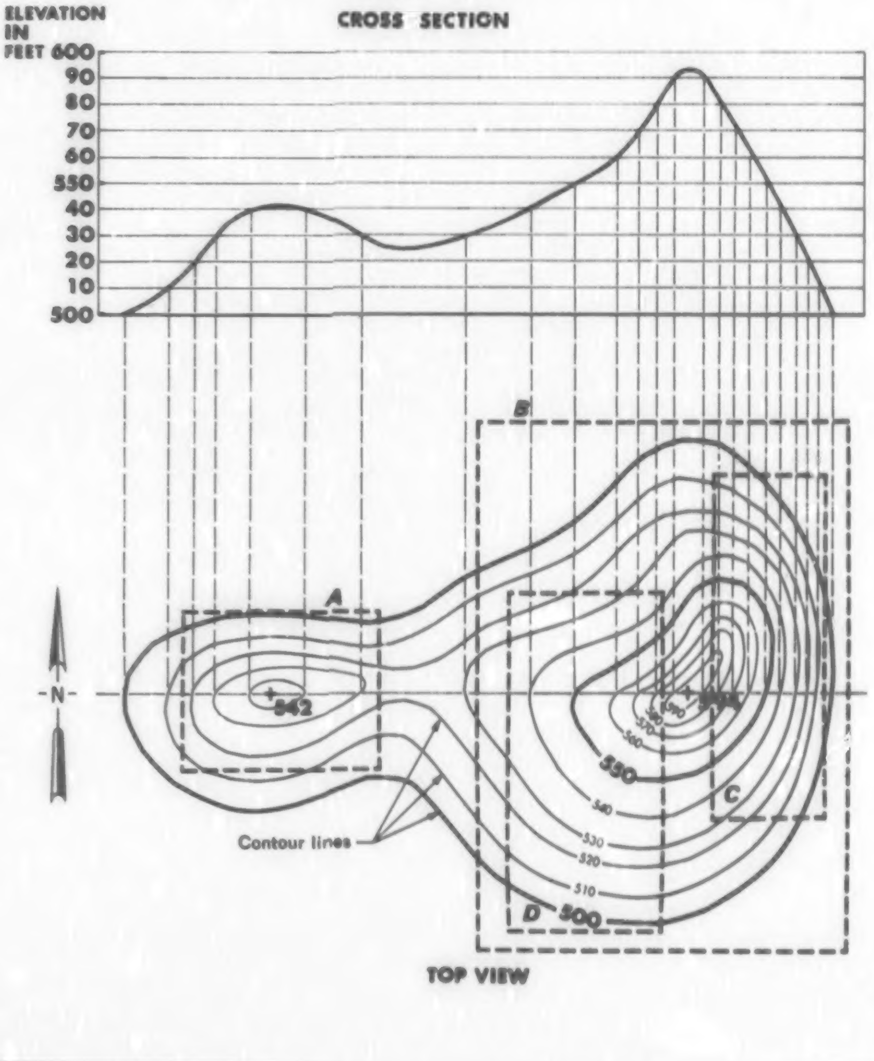
Topographic maps are part of your sanitary landfill plan. They allow the engineer to add the dimension of elevation to a two dimensional sheet of paper. Contour lines are used to give the third dimension to paper. The contour symbol may be defined as an imaginary line on the ground which takes any shape necessary to maintain a constant elevation above sea level.

Characteristics of Contour Lines (Refer to Fig 11.1)

1. The slope is steep when the contour lines are spaced closely together.
2. The slope is gentle when contour lines are spaced far apart.
3. A closed contour line on a map represents either a summit or a depression.
4. Contour lines cannot merge or cross each other except in rare cases such as vertical or overhanging cliffs.

Figure 11.1 is an example of a contour map with a corresponding profile.

FIGURE 11.1

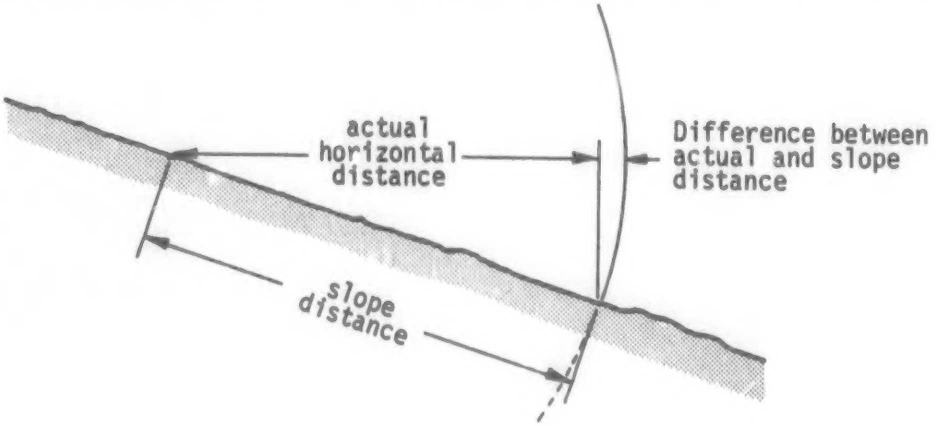

ELEVATION IN FEET
CROSS SECTION
600
90
80
70
60
550
40
30
20
10
500
A
B
C
D
542
590
580
570
560
550
540
530
520
510
500
N
Contour lines
TOP VIEW

The contour interval for Figure 11.1 is ten feet. That is, between each contour line the change in elevation is ten feet. Areas A and B show two hills. The western hill rises from elevation 500 to elevation 542. The eastern hill rises from elevation 500 to elevation 594. Closed contour lines represent either a summit or depression: in this example, the closed contour lines represent hills because the elevation numbers are increasing. If the numbers were getting smaller the sample would be representing two depressions. Area C has a series of closely spaced contour lines which represent a steep slope. Area D has widely spread contour lines which represent a gentle slope.

Horizontal Distance Measurement

Two practical ways to measure horizontal distance at a sanitary landfill are either to pace it off by foot or use the engineer's chain. Pacing, the least accurate of the methods of distance measurement, is the handiest and is suited to estimating distances and rough work. The length of pace varies with each person and his walking speed. Each individual should determine how many paces he takes to get 100 feet. A natural pace and an average gait should be used in determining the number of paces in 100 feet. Once the pace for an individual has been determined it can be used for measuring distances. When grades are steep, you will have to lengthen your stride so that your normal number of paces will result in a horizontal distance of 100 feet. (Figure 11.2)

FIGURE 11.2
Difference between horizontal distance and distance measured on a slope

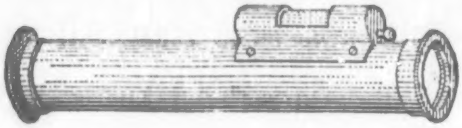

actual horizontal distance
Difference between actual and slope distance
slope distance

The engineer's chain is a 100 foot steel tape with foot divisions which are likewise divided into 10 parts. The chain will give much more accurate readings of slope distance than pacing.

Vertical Distance Measurement

The hand level provides sufficient accuracy for measuring vertical distance at a sanitary landfill. One kind is illustrated in Figure 11.3.

FIGURE 11.3
A hand level



When looking through the hand level you will see the tube divided into two parts. Figure 11.4a. On one side you view the object you are looking at. On the other side you will see the level bubble with cross-hairs. When the bubble is centered, the point where the center cross-hair crosses the object is the point where your eye height meets the object. Figure 11.4b.

FIGURE 11.4a

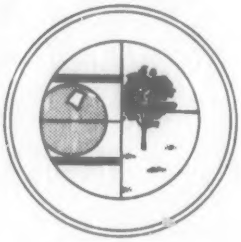
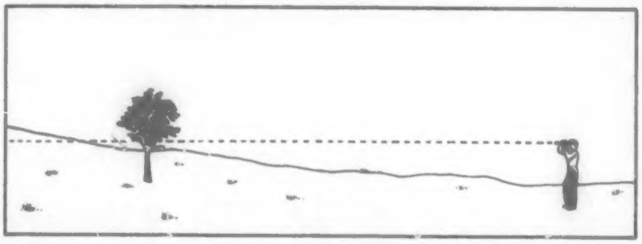


FIGURE 11.4b



In order to determine a grade using a hand level you must:

1. Pick a stationary point (like a stake) on the upgrade side of the slope;
2. pace off a distance until your eyes are looking approximately at the base of the stake;
3. use the hand level to see if your line of sight is directly toward the stake. If it is not, move backward or forward until the bubble in the hand level is between the cross-hairs;
4. measure the vertical distance from your eyes to the ground; and
5. calculate the grade or slope by the formula slope =

$$\frac{\text{distance from your eyes to the ground}}{\text{horizontal distance from stake to your feet}}$$

xample Problem (Figure 11.5).

1. Place a stake at the upper part of the slope.

2. Pace off a distance long enough so that when you look back at the stake your eyes are looking directly at the bottom of the stake. Remember that your paces going downhill should be longer to compensate for the slope. (See Figure 11.2). Assume for this problem that you have determined that your pace is 2½ feet and you took thirty paces before you thought your eyes were even with the bottom of the stake. Your distance from the stake is:

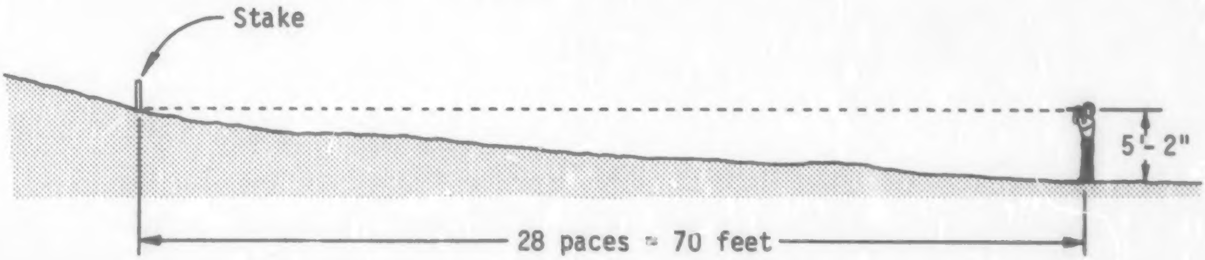
   30 paces X 2½ feet/pace = 75 feet

3. To be sure your are looking directly at the bottom of the stake, look through the hand level. If you are looking at the bottom of the stake and the bubble is not between the cross-hairs, you will have to move either forward or backward. Assume for this problem that the bubble is too high. You are therefore too far away from the stake. Take two steps up the hill and look through the hand level again. Assume again that this time the bubble lines up between the cross-hairs when you look at the stake through the hand level. Your horizontal distance from the stake is now:

   2 paces X 2½ feet/pace = 5 feet

   75 feet - 5 feet = 70 feet

FIGURE 11.5
Sighting a stake with a hand level



4. Assume for this problem that the vertical distance from your eyes to the ground is 5 feet - 2 inches.

5. Therefore the slope or grade is the vertical distance from your eyes to the ground divided by the horizontal distance from the stake to you.

$$\text{grade} = \frac{5 \text{ feet} - 2 \text{ inches}}{70 \text{ feet}}$$

$$\text{grade} = \frac{5\ 2/12 \text{ feet}}{70 \text{ feet}} = \frac{62/12}{70} = 0.073$$

Therefore the slope or grade is 0.07 or 7%.

CHAPTER 12

OSHA AND SAFETY

The OSHA law was written to protect the employee from injury and the employer from possible law suits. There is nothing, however, that governs the safety of the users of the sanitary landfill when they are on the site. This makes total control by the sanitary landfill operator even more important. Vehicles must be "spotted" to avoid accidents.

Another job for both the spotter and the equipment operator is to watch for hot loads. All sanitary landfills must have at least one fire extinguisher and arrangements to handle any fire themselves or through the local fire fighting department. But preparations can be made to handle hot loads. These are:

1. dirt or water in large quantities,
2. space to work in,
3. roads to get to the hot load.

The following rules of the Department of Labor, Occupational Safety and Health Administration (OSHA) are included to bring these requirements to the attention of the landfill operator. These rules are enforceable by OSHA inspectors.

1. Fire Protection and Prevention

    a. The employer shall be responsible for the development of a fire protection program to be followed throughout all phases of the construction and demolition work, and he shall provide for the firefighting equipment as specified in this subpart. As fire hazards occur, there shall be no delay in providing the necessary equipment. Section 1926.150(a)(1).

    b. Access to all available firefighting equipment shall be maintained at all times. Section 1926.150(a) (2).

    c. All firefighting equipment, provided by the employer, shall be conspicuously located. Section 1926.150(a) (3).

    d. All firefighting equipment shall be periodically inspected and maintained in operating condition. Defective equipment shall be immediately replaced. Section 1926.150(a) (4).

2. General Safety and Health Provisions

    a. Section 107 of the Act requires that it shall be a condition of each contract which is entered into under legislation subject to Reorganization Plan Number 14, of 1950 (64 Stat. 1927), as defined in Section 1926.12, and is for construction, alteration, and/or repair, including painting and decorating, that no contractor or subcontractor for any part of the contract work shall require any laborer or mechanic employed in the performance of the contract to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health or safety. Section 1926.20(a) (1).

3. Occupational Health and Environmental Controls

a. First-aid supplies approved by the consulting physician shall be easily accessible when required. Selection 1926.50(d)(1).

b. An adequate supply of potable water shall be provided in all places of employment. Section 1926.51(a)(1).

c. Toilets shall be provided for employees according to the following table:

Table D-1

Number of Employees	Minimum Number of Facilities
20 or less	1
20 or more	1 toilet seat and 1 urinal per 40 workers.
200 or more	1 toilet seat and 1 urinal per 50 workers.

Section 1926.51(c)(1)

d. Under temporary field conditions, provisions shall be made to assure not less than one toilet facility is available. Section 1926.51(c)(2).

e. The employer shall provide adequate washing facilities for employees engaged in the application of paints, coating, herbicides, or insecticides, or in other operations where contaminants may be harmful to the employees. Such facilities shall be in near proximity to the worksite and shall be so equipped as to enable employees to remove such substances. Section 1926.51(f).

4. Motor Vehicles, Mechanized Equipment, and Marine Operations

a. These rules apply to the following types of earthmoving equipment: scrapers, loaders, crawlers, or wheel tractors, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment. The promulgation of specific rules for compactors and rubber-tired "skid-steer" equipment is reserved pending consideration of standards currently being developed. Section 1926.602(a)(1).

b. Seat belts shall be provided on all equipment covered by this section and shall meet the requirements of the Society of Automotive Engineers, J386-1969, Seat Belts for Construction Equipment. Seat belts for agricultural and light industrial tractors shall meet the seat belt requirements of Society of Automotive Engineers J333a-1970, Operator Protection for Agricultural and Light Industrial Tractors.

(ii) Seat belts need not be provided for equipment which is designed only for standup operation.

(iii) Seat belts need not be provided for equipment which does not have roll-over protection structure (ROPS) or adequate canopy protection. Section 1926.602(a)(2).

CHAPTER 13

RECORDS

Why is it important to keep accurate records? Cost control, budgeting, and future planning are the most important reasons. Daily records are needed on the amounts of solid wastes delivered and money received. Waste quantities can be kept in terms of weight, or if scales are not available, in volume.

INFORMATION REQUIRED

There is certain information which should be recorded for every load arriving at the landfill. Two forms can be used for recording purposes; the weight slip and a form similar to the "Daily Truck Weight Record" shown on the following page. Weight slips vary from sanitary landfill to sanitary landfill, but normally identify the vehicle, the time and date of delivery, the gross and tare (vehicle) weight, and the charges assessed or collected.

The "Daily Truck Weight Record" contains the basic information needed for landfill operations. It is your job to record information accurately for each load to summarize the totals for each day. Let's look at what information is required for this form and why it is recorded.

1. Vehicle identification number. This number is recorded to aid in identifying customers, where waste came from, and for billing purposes.

2. Time of day. This information can be helpful in scheduling labor requirements on the fill and for billing purposes.

3. Quantity, source, and type of waste. For each load, the weight of waste should be determined or the volume estimated. The weight is usually determined by weighing the loaded vehicle and subtracting the tare weight from the total. The source and type of solid waste should also be noted. When scales are not available, cubic yards should be recorded. The cubic yards can be determined by visual estimate, by actually measuring the capacity of trucks which frequent the site or by use of a table as in Table 13-1.

   The quantity of waste delivered is important for scheduling daily operations, budgeting, and planning purposes. It provides the information needed to:

   - Determine the rate at which the sanitary landfill is being used, and thereby how long before a replacement site must be found.

   - Determine the rate at which solid waste is generated in the area using the sanitary landfill; such information is needed when a new site is chosen.

   - Prepare bills for regular customers.

   - Measure how well the sanitary landfill is being operated. For example, comparing the man-hours or total costs for disposing of a certain quantity of waste with similar figures for another period gives a measure of efficiency.

TABLE 13.1
Cubic yards of material in a truck box of given length and depth

Length of truck box (ft)	depth of waste in truck box (ft)						
	1'	2'	3'	4'	5'	6'	7'
6'	1.7	3.3	5.0	6.7	8.3	10.0	11.7
8'	2.2	4.4	6.7	8.8	11.1	13.3	15.6
10'	2.7	5.6	8.3	11.1	13.8	16.7	19.4
12'	3.3	6.7	10.0	13.3	16.7	20.0	23.3
14'	3.9	7.8	11.7	15.6	19.4	23.3	27.2
16'	4.4	8.9	13.3	17.8	22.2	26.7	31.1

* This assumes the inside of the box is 7'6" wide

FIGURE 13.1

DAILY TRUCK WEIGHT RECORD

DATE: / /

Truck ident.	Time*	Wastes		Weight in	Weight out (tare weight)	Amount delivered	
		Source†	Type‡			Solid waste	Cover mat'l
Totals	X	X	X	X	X		

Instructions: To be completed by weighmaster for each truck, each time it makes a delivery. If scales are not available, an estimate of cubic yards is acceptable.

* Only record time at 15-minute intervals.

† Sources: R = residential, I = industrial, C = commercial, A = agricultural, etc.

‡ Types: H = household refuse, D = demolition/construction wastes, T = tires, B = bulky waste — furniture, refrigerators, etc.

The source and type of wastes are used when planning for daily operations or for a replacement site. Special equipment or handling methods may be needed for certain types of waste.

4. Cover material imported. If cover material is imported to the sanitary landfill, record the amounts delivered. The amounts are important if the cover material is to be paid for and also to ensure that the proper amounts are being used for covering waste.

WHAT HAPPENDS TO THE INFORMATION

The daily totals along the bottom of the "Daily Truck Weight Record" will be used in filling out the "Daily Activity Summary" report shown on the following page.

These two forms are beginning points for a cost accounting system for the fill. Top management uses them to determine how well the sanitary landfill is being operated and where excessive costs lie. Since important decisions are made based on the various summary reports that reach top management, you must be sure they are accurate.

FIGURE 13.2

DAILY ACTIVITY SUMMARY

DATE: ______ / ______ / ______

DAY	Solid waste		Cover material				Man hrs.	Machine hrs.		Expense*		Sit hrs.
	Loads	Tons	Begin	Rec'd	Used	Remain		Use	Down	$	Type	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
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19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
Totals			X			X					X	

Instructions: To be completed by landfill supervisor at the end of each day. Some of data is to be summarized from Forms 1 and 2. Record cover material in either tons or cubic yards. Today's beginning cover material equals yesterday's remaining.

*Record only miscellaneous expenses that would not be recorded by the accounting department and are incurred at the site.

CHAPTER 14

INSPECTIONS

The Department of Environmental Quality is required by state law to inspect all sanitary landfills at least once each year. The Department of Environmental Quality usually makes one major inspection and two minor inspections of each sanitary landfill each year. These inspections are not something to be afraid of, but are meetings you should use to improve the operation of the sanitary landfill. The inspections are made of an informal basis and cover the items listed on the following inspection sheet. You will be asked to accompany the inspector and help him complete the form. You should ask the inspector why certain operating practices are not in compliance and what should be done to improve them.

After the inspection has been completed, the report is sent to the central office in Des Moines for review. A copy will be sent to you by mail officially informing you of what action if any is needed to bring the sanitary landfill into compliance. If you have any questions about this, please contact the Land Quality Management Division.

The following is a copy of the inspection form which is presently used.

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY
SANITARY LANDFILL INSPECTION

Page 1 of ____

____________ Permit #

Site: ______________________ Reg.#: ____ County: ____________
Operator: ______________________ Phone #: ____/____/____
Address: ______________________
Responsible official: ______________________ Title: ____________
Address: ______________________ Phone #: ____/____/____
Date of last inspection: ________ Daily waste volume: ________ tons/________ cu. yds.

I. PLAN REQUIREMENTS: Were alterations or deviations from the approved plans noted?*

Item	Yes	No	Item	Yes	No
1. DRAINAGE STRUCTURES			6. FILL ELEVATIONS		
a. dikes and berms			7. LIFT HEIGHTS		
b. terraces			8. WET WEATHER SITES		
c. tile lines			9. MONITORING WELLS		
d. ditches			a. location		
2. INTERNAL ROADS			b. sample frequency		
a. location			10. REQUIRED EQUIPMENT		
b. construction/drainage			11. REQUIRED MANPOWER		
3. FILL SEQUENCE & TYPE			12. HAZARDOUS WASTE AUTH.		
a. present location			13. PERMITS & PLANS		
b. future location			14. BUFFER ZONE (20' & 500')		
4. BASE WORK			15. LANDSCAPE SCREENS		
a. compaction/sealing			16. PERMIT SPECIAL CONDITIONS		
b. drainage structures			17. OTHER (see comments)		
5. EXCAVATION ELEVATIONS					

II. OPERATING PROCEDURES: Were problems noted with these aspects of operation?*

Item	Yes	No	Item	Yes	No
18. DRAINAGE			27. OPEN BURNING		
a. cover erosion			28. RODENTS AND INSECTS		
b. ponding			29. CONST/DEMO WASTES		
c. leachate			30. MANPOWER		
d. drainage into fill			a. operator		
19. FILL COVER			b. attendant		
a. daily			c. training		
b. intermediate (7 day)			31. EQUIPMENT		
c. final (60 day)			a. adequate		
20. CONTROL OF FACE			b. maintenance		
a. width			c. backup available		
b. slope			32. ROAD ADEQUACY		
c. dumping location			33. ON-SITE FACILITIES		
21. COMPACTION			a. showers and restrooms		
22. LITTER CONTROL			b. telephone/commun.		
a. fences			c. perimeter fences/gates		
b. hand picking			d. signs		
23. WET WEATHER OPERATIONS			e. fire control		
24. COLD WEATHER OPERATIONS			f. maintenance facilities		
25. SALVAGING			34. HAZARDOUS WASTE HANDLING		
26. SCAVENGING			35. OTHER		

*Yes - see comments section
No - no problems were noted
No entry - item not applicable
or not observed

Inspector: ______________________ Date: ________
(Signature)

Approved by: ______________________ Date: ________
(Signature)

CHAPTER 15

SOURCES OF ASSISTANCE

There are a number of contacts which may be of help in answering questions which may come up in operating a sanitary landfill. Among these are:

1) The Land Quality Management Division of the Iowa Department of Environmental Quality in Des Moines;

2) The Regional Office of the Iowa Department of Environmental Quality serving your area; and,

3) The consulting engineer which designed the sanitary landfill.

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY - Land Quality Management Division

The Land Quality Management Division is available to assist the sanitary landfill operator whenever a problem arises. The Division staff has visited and reviewed many land disposal sites and know what problem as an operator can run into.

The Land Quality Management Division staff cannot change the approved sanitary landfill plans or operating procedures described in the plans without their first being submitted by a consulting engineer. The staff can, however, recommend to the responsible official in charge of the disposal site that changes be made to improve the operation. Because these changes can be expensive, the staff will recommend changes be made only when it is necessary.

If you, as the operator of a sanitary landfill, are having problems with litter control, wet weather operation, or special wastes, the Land Quality Management Division should be contacted for assistance. Do not hesitate to contact the Land Quality Management Division concerning any problem you have with the operation of the sanitary landfill or with solid waste in general.

And, remember, before hazardous or toxic waste may be disposed of at the sanitary landfill, the Land Quality Management Division must be notified and the disposal approved.

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY - Regional Offices

There are six regional Iowa Department of Environmental Quality offices to provide assistance to sanitary landfill operators. The main responsibility of the regional offices is to inspect sanitary landfills to make sure they are being operated in compliance with both the solid waste disposal rules and the approved sanitary landfill plans. Since the regional offices visit the site regularly and are familiar with the operation, they should be contacted concerning minor problems at the sanitary landfill.

At the time the staff from the regional offices are making their routine inspections, any problems or questions you may have can be answered at that time. Because the inspection cannot be completed without talking to the operator, the regional staff will seek your assistance too.

The map in Figure 15.1 shows where the regional offices are located, their phone numbers and the counties they are responsible for. If you have any questions either the regional office that is responsible for your county or the Land Quality Management Division in Des Moines may be contacted.

CONSULTING ENGINEER

The operator should be involved with the consulting engineer when the operating plans are being prepared. The operating plans show where roads are to be located, how they are to be built, where and how building are to be built, and the specific procedures on how the site will be operated, and filled. These are things important to the operator because they tell him how he must do his job. If he can tell the consultant what his ideas are in the initial planning stages of the operating plan, it is more likely the consultant will listen to him.

The operating plan developed by the consultant, submitted to and approved by the Iowa Department of Environmental Quality becomes the operator's "bible" on how the sanitary landfill must be operated. All requirements listed in the Iowa Department of Environmental Quality rules on sanitary landfills are given in the operating plan and how they are to be handled. The operating procedures, operating order, and improvements given in the operating plan must be followed exactly.

When an employee from the Iowa Department of Environmental Quality inspects a sanitary landfill, he determines if the operator is operating according to the plan. If the site is not in compliance, it is possible the sanitary landfill's permit may be suspended or revoked. This means the sanitary landfill would have to close until it returned to the approved operating procedures.

Therefore, it is important to you as an operator to know what the operating plans say.

If changes in the operating plan need to be made, it is not the operator's duty to change them without approval. The operator should contact his supervisor and explain what is wrong and why the plans need to be changed. The supervisor will contact the consultant and then the operator should explain to the consultant what the problems are. If a change is to be made, a revised set of plans must be sent to the Iowa Department of Environmental Quality for approval and a revised permit issued.

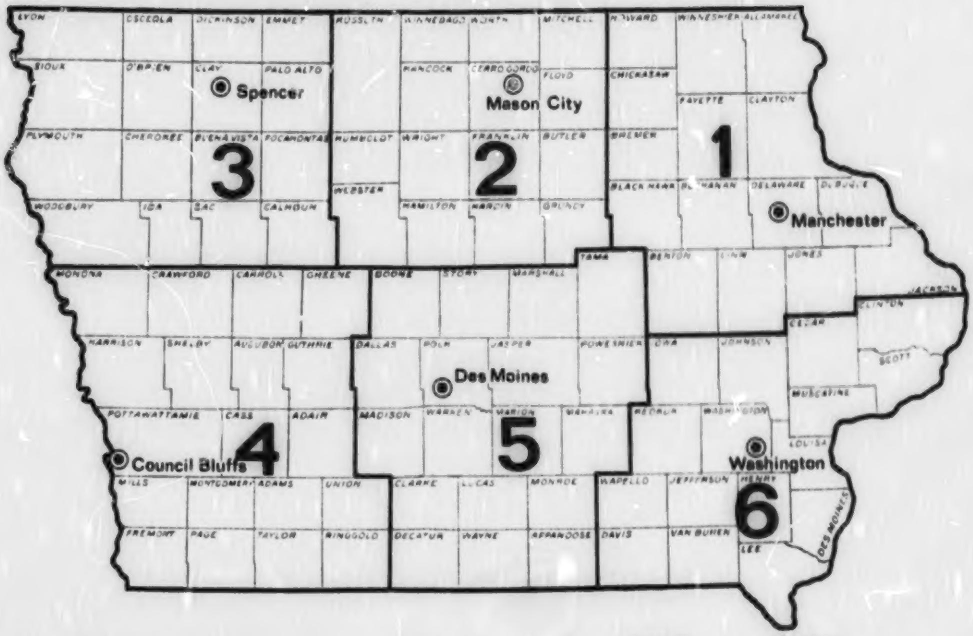
OTHER ASSISTANCE

Other sources of assistance are available from the county engineer, university extension, the Iowa Department of Labor, the Soil Conservation Service, neighboring sanitary landfill operators and others depending on what the problem is.

If you do not know who to contact concerning a specific problem, you should contact the Land Quality Management Division first. The Land Quality Management Division will either contact someone for you or tell you who should be contacted. Remember that assistance is available and you should not be reluctant to ask for it.

FIGURE 15.1

REGIONAL OFFICES
DEPARTMENT OF ENVIRONMENTAL QUALITY


Spencer
Mason City
Manchester
Des Moines
Council Bluffs
Washington
1
2
3
4
5
6
LYON
OSCEOLA
DICKINSON
EMMET
KOSSUTH
WINNEBAGO
WORTH
MITCHELL
HOWARD
WINNESHIEK
ALLAMAKEE
SIOUX
O'BRIEN
CLAY
PALO ALTO
HANCOCK
CERRO GORDO
FLOYD
CHICKASAW
FAYETTE
CLAYTON
PLYMOUTH
CHEROKEE
BUENA VISTA
POCAHONTAS
HUMBOLDT
WRIGHT
FRANKLIN
BUTLER
BREMER
WEBSTER
HAMILTON
HARDIN
GRUNDY
BLACK HAWK
BUCHANAN
DELAWARE
DUBUQUE
WOODBURY
IDA
SAC
CALHOUN
TAMA
BENTON
LINN
JONES
JACKSON
MONONA
CRAWFORD
CARROLL
GREENE
BOONE
STORY
MARSHALL
CLINTON
CEDAR
HARRISON
SHELBY
AUDUBON
GUTHRIE
DALLAS
POLK
JASPER
POWESHIEK
IOWA
JOHNSON
SCOTT
MUSCATINE
POTTAWATTAMIE
CASS
ADAIR
MADISON
WARREN
MARION
MAHASKA
KEOKUK
WASHINGTON
LOUISA
MILLS
MONTGOMERY
ADAMS
UNION
CLARKE
LUCAS
MONROE
WAPELLO
JEFFERSON
HENRY
FREMONT
PAGE
TAYLOR
RINGGOLD
DECATUR
WAYNE
APPANOOSE
DAVIS
VAN BUREN
LEE
DES MOINES

REGION	LOCATION	ADDRESS	P.O. BOX	TELEPHONE NO.	REGIONAL ADMINISTRATOR
1	MANCHESTER-52057	209 NORTH FRANKLIN ST.		319/297-2640	JERRY L. RATTENBORG
2	MASON CITY-50401	1450 NORTH FEDERAL	1443	515/424-4073	WILLIAM J. MEEKER
3	SPENCER-51301	401 GRAND AVE., SUITE 24	270	712/262-4177	JOHN METCALFE
4	COUNCIL BLUFFS-51501	532 FIRST AVE., SUITE 304		712/328-3194	R.W. GROTE
5	DES MOINES-50309	317 E. 5th ST., SUITE 21	6160	515/281-3622	JACK W. CLEMENS
6	WASHINGTON-52353	111½ NORTH MARION	27	319/653-2135	EARL C. VOELKER, SR.

APPENDIX A

Code of Iowa
Chapter 455B
Division IV
Part 1

SOLID WASTE

DIVISION IV
SOLID WASTE DISPOSAL COMMISSION
PART I
SOLID WASTE

455B.75 Definitions. As used in this part 1 of division IV, unless the context clearly indicates a contrary intent:

1. "Public agency" means a public agency as defined in section 28E.2.

2. "Private agency" means a private agency as defined in section 28E.2.

3. "Sanitary disposal project" means all facilities and appurtenances including all real and personal property connected with such facilities, which are acquired, purchased, constructed, reconstructed, equipped, improved, extended, maintained, or operated to facilitate the final disposition of solid waste without creating a significant hazard to the public health or safety, and which are approved by the executive director.

4. "Solid waste" means garbage, refuse, rubbish, and other similar discarded solid or semisolid materials, including but not limited to such materials resulting from industrial, commercial, agricultural, and domestic activities. Solid waste may include vehicles, as defined by section 321.1, subsection 1. Nothing herein shall be construed as prohibiting the use of dirt, stone, brick, or similar inorganic material for fill, landscaping, excavation or grading at places other than a sanitary disposal project.

5. "Commission" means the solid waste disposal commission of the department.

NEW SUBSECTION. "Resource recovery system" means the recovery and separation of ferrous metals and nonferrous metals and glass and aluminum and the preparation and burning of solid waste as fuel for the production of electricity. [C71,§406.2; C73,§455B.75; 66 GA, Ch 228,§1]

Referred to in §§332.44, 346.23

455B.76 Duty of cities and counties. Every city and county of this state shall provide for the establishment and operation of a sanitary disposal project for final disposal of solid waste by its residents not later than July 1, 1975. Sanitary disposal projects may be established either separately or through co-operation efforts for the joint use of the participating public agencies as provided by law.

Cities and counties may execute with public and private agencies contracts, leases, or other necessary instruments, purchase land and do all things necessary not prohibited by law for the collection of solid waste, establishment and operation of sanitary disposal projects, and general administration of the same. Any agreement executed with a private agency for the operation of a sanitary disposal project shall private agency conditioned upon the faithful performance of the agreement. [C71,§406.3; C73,§455B.76; 65GA, ch 1087,§32]

455B.77 Administrator's duties. The executive director shall administer the provisions of this part 1 of division IV subject to the rules established by the commission.

Local boards of health shall co-operate in the enforcement of the provisions of said part and the executive director may seek their aid and delegate administrative duties of the department to the local boards of health in matters relating projects. [C71,§406.4; C73,§455B.77]

455B.78 Rules established. The commission shall establish rules for the proper administration of the provisions of this part 1 of division IV which shall reflect and accommodate insofar as is reasonably possible those current and generally accepted methods and techniques for treatment and disposition of solid waste which will serve the purposes of said part which shall take into consideration such factors, including others which it may deem proper, as existing physical conditions, topography, soils and geology, climate, transportation, and land use, such rules including but not limited to rules relating to the establishment and location of sanitary disposal projects, sanitary practices, inspection of sanitary disposal projects, collection of solid waste, disposal of solid waste, pollution controls, the issuance of permits, approved methods of private disposition of solid waste, the general operation and maintenance of sanitary disposal projects, and the implementation of said part. Prior to issuance of rules or amendments thereto, the commission shall hold at least one public hearing on the proposed rules or amendments, and shall give notice of such hearing at least thirty days in advance by publishing notice in a newspaper of general circulation in the state. The air quality commission and the water quality commission of the department shall co-operate with the commission in the establishment of such rules. All rules promulgated shall be subject to the provisions of chapter 17A and section 455B.7, subsection 3. [C71,§406.5; C73,§455B.78]

455B.79 Certification of plans by director. The executive director shall certify if disposal projects operated or planned to be operated by or for cities, counties and those operated by private agencies meet the standards provided for by this part 1 of division IV and the rules of the commission, by issuing a permit for existing disposal projects which fully comply, and for planned sanitary disposal projects whose plans fully comply, with all provisions of said part and rules issued pursuant thereto. Permits shall be issued for existing disposal sites which have not met all the provisions of said part and rules issued pursuant thereto, if a comprehensive plan for compliance within the time limitations required by said part is developed by a city, county or private agency and is approved by the executive director.

Every city or county of this state and every private agency involved in the final disposal of solid waste shall qualify for a permit by the first of July 1975 or be subject to such legal actions authorized by section 455B.82.

Permits shall be issued without fee by the executive director or at his direction, by a local board of health, for each sanitary disposal project operated in this state. Such permits shall be issued in the name of the city or county or, where applicable, in the name of the public or private agency operating such project. Each sanitary disposal project shall be inspected annually by the department or a local board of health. The permits issued pursuant to this section shall be in addition to any other licenses, permits or variances authorized or required by law, including, but not limited to, the provisions of chapter 358A. A permit may be suspended or revoked after notice and hearing before the commission or its designee if a sanitary disposal project is found not to meet the requirements of the provisions of said part or rules issued pursuant thereto. [C71,§406.6; C73,§455B.79; 65GA, ch 1087,§32]

455B.80 Plans filed. Every city, county and every private agency operating or planning to operate a sanitary disposal project shall file with the executive director a plan detailing the method by which the city, county or private agency will comply with the provisions of this part 1 of division IV. The executive director shall review each plan submitted and may reject, suggest modification, or approve the proposed plan. The executive director shall aid in the development of plans for compliance with the provisions of said part. The executive director shall make available to each city, county and private agency appropriate forms for the submission of plans and may hold hearings for the purpose of implementing the provisions of said part. The executive director and governmental agencies with primary responsibility for the development and conservation of energy resources shall provide research and assistance, when cities and counties operating or planning to operate sanitary disposal projects request aid in planning and implementing resource recovery systems. [C71,§406.7; C73,§455B.80; 65GA, ch 1087, §32; 66GA, ch 228,§2]

455B.81 Tax levy. The board of supervisors of any county may, in lieu of the levy authorized by section 332.32, annually levy a tax not to exceed six and three-fourths cents per thousand dollars of assessed value of taxable property in the county outside the incorporated limits of any city for the purpose of planning a sanitary disposal project or of paying the interest and principal of bonds issued pursuant to the provisions of section 346.23 as they become due. The levy authorized by this section shall be the only levy that the board of supervisors may authorize for the purposes of this section, notwithstanding the provisions of section 346.11 or any other provision of law. [C71,§406.8; C73, §455B.81; 65GA, ch 1087, §32, ch 1231,§153]

Referred to in §346.23

455B.82 Dumping-where prohibited.

1. Commencing July 1, 1975, it shall be unlawful for any private agency or public agency to dump or deposit or permit the dumping or depositing of any solid waste at any place other than a sanitary disposal project approved by the executive director. This section shall not prohibit a private agency or public agency from dumping or depositing solid waste resulting from its own residential, farming, manufacturing, mining or commercial activities on land owned or leased by it if such action does not violate any statute of this state or rules promulgated by the commission or local boards of health, or local ordinances, or rules issued by the air quality commission or water quality commission of the department. The executive director may issue temporary permits for dumping or disposal of solid waste at disposal sites for which an application for a permit to operate a sanitary disposal project has been made and which have not met all of the requirements of part one (1) of this division and the rules adopted by the commission if a compliance schedule has been submitted by the applicant specifying how and when the applicant will meet the requirements for an operational sanitary disposal project and the executive director determines the public interest will be best served by granting such temporary permit.

2. The executive director may issue any order necessary to secure compliance with or prevent a violation of the provisions of this part 1 of division IV or the rules promulgated pursuant thereto. The attorney general shall, on request of the department, institute any legal proceedings necessary in obtaining compliance with an order of the commission or the executive director or prosecuting any person for a violation of the provisions of said part or rules issued pursuant thereto.

NEW SUBSECTION. Any person who violates any provision of part one (1) of this division or any rule or any order promulgated or the conditions of any permit or order issued pursuant to part one (1) of this division shall be subject to a civil penalty not to exceed five hundred dollars for each day of such violation. [C71,§406.9; C73,§455B.82; 66GA, ch 59,§§5 and 6]

Referred to in §455B.79

455B.83 Appeal from order. Any person aggrieved by an order of the commission or the executive director may appeal the same by filing a written notice of appeal with the executive director within thirty days of the issuance of the order. The executive director shall schedule a hearing for the purpose of hearing the arguments of the aggrieved person with thirty days of the filing of the notice of appeal.

The hearing may be held before the commission or its designee. A complete record shall be made of the proceedings. The executive director shall issue the findings in writing to the aggrieved person within thirty days of the conclusion of such hearing. Judicial review may be sought of actions of the commission or executive director in accordance with the terms of the Iowa administrative procedure Act. Notwithstanding the terms of said Act, petitions for judicial review may be filed in the district court of the county wherein the acts in issue occurred. [C71,§406.10; C73,§455B.83; 65GA, ch 1090, §158]

455B.84 Modification of rules. Any rule adopted or order issued under chapter 406 of prior Codes by the commissioner of public health shall remain effective until modified or rescinded by action of the solid waste disposal commission unless such rule is inconsistent or contrary to this part 1 of division IV. [C73,§455B.84]

PART 2
RADIOACTIVE WASTE

455B.85 Definitions. As used in this part 2 of division IV, unless the context otherwise requires:

1. "Radiation" means any ionizing radiation including, but not limited to, high-speed electrons, neutrons, protons and other nuclear particles, but not sound waves.
2. "Radioactive material" means any solid, liquid, or gaseous material which emits radiation spontaneously.
3. "Nuclear waste disposal site" means all facilities and appurtenances including all real and personal property connected with such facilities, which are acquired, leased, purchased, constructed, reconstructed, equipped, improved, extended, maintained, or operated to facilitate the final disposition of radioactive waste without creating a significant hazard to the public health or safety, and which are approved by the executive director.
4. "Commission" means solid waste disposal commission of the department. [C73,§455B.85]

455B.86 Policy. The department shall be the agency of the state to establish policy for the transportation, storage, handling, and disposal of radioactive material for the purpose of protecting the public health and safety. [C73,§455B.86]

455B.87 Rules for transporting. The commission shall provide, by rule, for the proper methods of transporting, storage, and handling of radioactive material except that the provisions of this section shall not apply to the transportation, handling, or storage of radioactive material by licensed physicians and surgeons or licensed osteopathic

APPENDIX B

Rules of the Solid Waste Disposal Commission
of the
Iowa Department of Environmental Quality

24.12(3) *Denial of renewal of a permit.* The permittee shall have a right to an evidentiary hearing on the denial of renewal of a waste water operation permit which has been issued pursuant to chapter 19, DEQ rules. The commission shall be the agency before which a hearing is held pursuant to this subrule.

24.12(4) *Permit conditions.* The permittee shall have a right to an evidentiary hearing on any condition or requirement of a waste water or water supply construction permit issued pursuant to chapter 19 or 22, DEQ rules, or of a waste water operation permit issued pursuant to chapter 19. The commission shall be the agency before which a hearing is held pursuant to this subrule. Such permits shall become effective upon issuance unless the permittee exercises the right to request an evidentiary hearing within the time allowed by subrule 24.12(5). Where the permittee exercises such right the permit shall be effective when the controversy over the subject permit conditions has been resolved informally or after hearing on the matter.

24.12(5) *Time for request.* An applicant or permittee must exercise the right to a hearing granted by subrule 24.12(2), 24.12(3) or 24.12(4) by requesting such a hearing within thirty days of the receipt of the notice of agency action on the permit. Failure to request a hearing within the thirty-day period shall terminate the right to any administrative hearing on the permit.

These rules are intended to implement chapters 17A and 455B of the Code.

[Filed 12/19/75, Notice 10/6/75—published 1/12/76, effective 2/16/76]

TITLE IV

SOLID WASTE DISPOSAL
CHAPTER 25
DEFINITIONS

400—25.1(455B) Definitions. For the purpose of these rules, the following terms shall have the meaning indicated in this chapter. The definitions set out in section 406.2, Code 1973 [455B.75, Code 1975] shall be considered to be incorporated verbatim in these rules.

25.1(1) *"Commission"* means the Iowa solid waste disposal commission.

25.1(2) *"Composting"* means the controlled, biological decomposition of selected solid organic waste materials under aerobic conditions resulting in an innocuous final product.

25.1(3) *"Construction and demolition waste"* means waste building materials including wood, metals and rubble which result from construction or demolition of structures. Such waste shall also include trees.

25.1(4) *"Construction and demolition waste disposal site"* means a sanitary landfill which accepts only construction and demolition wastes.

25.1(5) *"Department"* means the Iowa state department of environmental quality.

25.1(6) *"Flood plain"* means the area adjoining a river or stream which has been or may be hereafter covered by flood water.

25.1(7) *"Garbage"* means all solid and semisolid, putrescible animal and vegetable wastes resulting from the handling, preparing, cooking, storing, serving and consuming of food or of material intended for use as food, and all offal, excluding useful industrial byproducts, and shall include all such substances from all public and private establishments and from all residences.

25.1(8) *"High water table"* is the position of the water table which occurs in the spring in years of normal or above normal precipitation.

25.1(9) *"Incineration"* means the processing and burning of waste for the purpose of volume and weight reduction in facilities designed for such use.

25.1(10) *"Land application"* means a method through which sludge is applied to the ground surface. Land application may include sub-surface injection.

25.1(11) *"Land pollution"* means the presence in or on the land of any solid waste in such quantity, of such nature and for such duration and under such condition as would affect injuriously any waters of the state, cause air pollution or create a nuisance.

25.1(12) *"Monitoring well"* means any well installed solely for the sampling of ground water quality at a given location and depth and constructed in a manner approved by the department.

25.1(13) *"Open burning"* means any burning of combustible materials where the products of combustion are emitted into the open air without passing through a chimney or stack.

25.1(14) *"Open dumping"* means the depositing of solid wastes on the surface of the ground or into a body or stream of water.

25.1(15) *"Private agency"* is defined in section 28E.2.

25.1(16) *"Public agency"* is defined in section 28E.2.

25.1(17) *"Public water supply system"* means a system for the provision to the public of piped water for human consumption, if such system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least sixty days out of the year. Such term includes (1) any collection, treatment, storage, and distribution facilities under control of the supplier of water and used primarily in connection with such system, and (2) any collection (including wells) or pretreatment storage facilities not under such control which are used primarily in connection with such supply system. A public water supply system is either a "community water system" or a "noncommunity water system".

a. "Community water system" means a public water supply system which serves at least fifteen service connections used by year-round residents or regularly serves at least twenty-five year-round residents.

b. "Noncommunity water system" means a public water supply system that is not a community water system.

25.1(18) *"Recycling"* means the reutilization of natural resources and man-made products.

25.1(19) *"Refuse"* means putrescible and nonputrescible wastes, including but not limited to garbage, rubbish, ashes, incinerator ash, incinerator residues, street cleanings, market and industrial solid wastes and sewage treatment wastes in dry or semisolid form.

25.1(20) *"Refuse collection service"* means a publicly or privately operated agency, business or service engaged in the collecting and transporting of solid waste for disposal purposes.

25.1(21) *"Rubbish"* means nonputrescible solid waste consisting of combustible and noncombustible wastes, such as ashes, paper, cardboard, tin cans, yard clippings, wood, glass, bedding, crockery or litter of any kind.

25.1(22) *"Rubble"* means stone, brick or similar inorganic material.

25.1(23) *"Salvageable material"* means discarded material no longer of value for its original purpose but which has value if reclaimed.

25.1(24) *"Salvaging"* means the systematic removal of salvageable material in a formal and orderly manner as a part of the normal operating procedure of a sanitary disposal project.

25.1(25) *"Sanitary disposal"* means a method of treating solid waste so that it does not produce a hazard to the public health or safety or create a nuisance.

25.1(26) *"Sanitary disposal project"* is defined in section 455B.75, Code 1975.

25.1(27) *"Sanitary landfill"* means a method of disposing of solid waste on land by utilizing the principles of engineering to confine the solid waste to the smallest practical volume and to cover it with a layer of earth so that no nuisance or hazard to the public health is created.

25.1(28) *"Scavenging"* means the uncontrolled removal of materials from the unloading or working area of a sanitary disposal project.

25.1(29) *"Shoreland"* means land within 300 feet of the high water mark of any natural or artificial, publicly or privately owned lake or any impoundment of water used as a source of public water supply.

25.1(30) *"Site"* means any location, place or tract of land used for collection, storage, conversion, utilization, incineration or burial of solid wastes.

25.1(31) *"Solid waste"* is defined in section 455B.75.

25.1(32) *"Solid waste collection"* means the gathering of solid waste from public and private places.

25.1(33) *"Solid waste storage"* means the holding of solid waste pending intermediate or final disposal.

25.1(34) *"Solid waste transportation"* means the conveying of solid waste from one place to another by means of vehicle, rail car, water vessel, conveyor or other means.

25.1(35) *"Toxic and hazardous wastes"* means waste materials, including but not limited to poisons, pesticides, herbicides, acids, caustics, pathological wastes, flammable or explosive materials and similar harmful wastes which require special handling and which must be disposed of in such a manner as to conserve the environment and protect the public health and safety.

25.1(36) *"Transfer station"* means a fixed or mobile intermediate solid waste disposal facility for transferring loads of solid waste, with or without reduction of volume, to another transportation unit.

25.1(37) *"Attendant"* means an employee of a sanitary disposal project who is not employed or assigned to operate the equipment used on the site.

25.1(38) *"Industrial sludge"* means any sludge produced by industrial activity.

25.1(39) *"Leachate"* means fluid that has percolated through solid waste and which contains contaminants consisting of dissolved or suspended materials, chemicals, or microbial waste products from the solid waste.

25.1(40) *"Open dump"* means any exposed accumulation of solid waste at a site other than a sanitary disposal project operating under a permit from the department.

25.1(41) *"Operating area"* means the immediate portion of a sanitary disposal project used for unloading and handling of solid waste to prepare it for processing or final disposal.

25.1(42) *"Operator"* means an employee of the sanitary disposal project who is employed and assigned to operate the equipment used on the site.

25.1(43) *"Processing facility"* means the site and equipment for the preliminary and incomplete disposal of solid waste, including but not limited to transfer, open burning, incomplete land disposal, incineration, composting, reduction, shredding and compression.

25.1(44) *"Stablized sewage sludge"* means sludge from wastewater treatment facilities that has been processed to a point where it has the ability to resist further change, produces minimal odor, and has achieved a substantial reduction in the pathogenic organism content. (The department recognizes principles of stabilization other than the conventional biological processes. Whether these processes produce a stabilized sludge will be evaluated on an individual basis.)

25.1(45) *"Trees"* means trunks, limbs, stumps, or branches from trees or shrubs and untreated, uncoated, chemically unchanged wood wastes. This shall not include wood products which are part of an otherwise defined waste or have been contaminated by coatings, treatments or metals.

25.1(46) *"Unstabilized sewage sludge"* means sludge from wastewater treatment facilities which is not treated to remove pathogens.

25.1(47) *"Sludge"* means any solid, semisolid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant or air pollution control facility or any other such waste having similar characteristics and effects.

These rules are intended to implement chapter 455B, Code 1975.

[Filed 9/1/71, amended 2/13/74, amended 6/2/75]
[Filed 2/25/77, Notice 9/22/76—published 3/23/77, effective 4/27/77]

CHAPTER 26
GENERAL REQUIREMENTS RELATING TO SOLID WASTE DISPOSAL

400—26.1(455B) Compliance. All solid waste shall be stored, collected, transported, utilized, processed, reclaimed or disposed of in a manner consistent with requirements of these rules.

400—26.2(455B) General conditions of solid waste disposal. Any solid waste which may be disposed at a site other than a sanitary disposal project pursuant to chapter 455B of the Code shall be disposed as provided in this rule.

26.2(1) Open dumping is prohibited except for rubble.

26.2(2) A public or private agency dumping or depositing solid waste shall do so in a manner that creates no public health hazard, nuisance or degradation of surface water or aquifers that are in actual or deemed to be of potential use as a water resource.

400—26.3(455B) Storage, collection and transportation of solid waste.

26.3(1) *Public agency responsibility.* Every city within its jurisdiction, and county in its unincorporated areas shall be responsible for the storage, collection and transportation of solid waste. Any powers, privileges or authority exercised in fulfilling this responsibility may be exercised and enjoyed jointly with any other public agency. The responsible public agency shall:

a. Provide either through a public or private agency, for an adequate, efficient, and sanitary system for the collection and transportation of all solid wastes originating from households, service premises, business establishments and industries within their jurisdiction which are not exempted by law.

b. Issue and enforce regulations, subject to review by the department, pertaining to the storage, collection and transportation of all solid waste within their jurisdiction. Such regulations shall be no less restrictive than those in subrule 26.3(2), and shall, as a minimum, include specifications for:

(1) Storage containers.
(2) Storage duration.
(3) Storage locations.
(4) Collection frequency.
(5) Vehicle design and operation.

26.3(2) *Container and vehicle standards.*

a. Vehicles or containers used for the collection and transportation of any solid waste shall be loaded and moved in such a manner that the contents will not fall, leak or spill therefrom, and shall be covered to prevent blowing or loss of material. Where spillage does occur, the material shall be picked up immediately by the collector or transporter and returned to the vehicle or container and the area properly cleaned.

b. Vehicles or containers used for the collection and transportation of garbage and similar putrescible wastes or refuse containing such materials shall be leakproof, durable and of easily cleanable construction. They shall be cleaned to prevent nuisances, pollution or insect breeding and shall be maintained in good repair.

c. Vehicles and containers used for the collection and transportation of toxic and hazardous wastes shall be so constructed that they can be loaded, moved and unloaded in a manner that does not create a danger to public health or safety and in compliance with the rules and federal and state laws and local ordinances and regulations.

400—26.4(455B) Details of management plan proposals. Cities, counties and private agencies which are planning to establish or operate a sanitary disposal project other than a sanitary landfill, to modify their solid waste management practices, or to revise their existing management plan, shall file with the executive director a plan or revision of an existing plan before implementing it.

26.4(1) Such a plan or revision shall include the following information:

a. Public and private agencies involved.

b. Population densities and projections.

c. Major waste contributors.

d. Existing collection and disposal practices in the service area.

e. Anticipated future industrial and commercial developments and their effects.

f. Status of the solid waste management plan of the service area and evidence that the facility or changes contemplated are compatible with it.

g. An evaluation of alternatives for the disposal or processing of solid waste.

h. Evaluation of energy needs, markets and goals in any resource recovery to be provided.

i. A description of the level of service expected.

j. A broad assessment of the costs and benefits of the methods or processes to be used including capital cost, projected net annual operating cost, and cost of land disposal of any waste which cannot be handled or is removed from the process.

k. A description of the methods of financing to be used.

400—26.5(455B) Contracts with permitted agencies.

26.5(1) Every city, county, and other public agency which complies with the requirements of chapter 455B of the Code for the disposal of solid waste by means of a contract with an agency holding a sanitary disposal project permit or by means of a contract with a hauler who has a contract with an agency holding a sanitary disposal project permit shall submit to the department a photostatic copy of that executed contract. All such agencies shall have on file at the department at all times a valid contract. When the term of the contract expires, a renewal of the contract or a new contract shall be submitted.

26.5(2) All public agencies which contract with a hauler to comply with the requirements of part 1 of division iv of chapter 455B shall include as terms of that contract that all solid waste collected by the hauler for that agency shall be hauled in vehicles which comply with the standards of subrule 26.3(2) and disposed at a sanitary disposal project permitted by the department.

400—26.6(455B) Closing of open dumps. Every public agency shall properly close or enforce the proper closing of all open dumps which are within the agency's jurisdiction. Every private agency shall properly close all open dumps under their control.

26.6(1) All open dumps shall be closed by July 1, 1975.

26.6(2) Proper closing shall include the following:

a. The dump shall be fenced to control access as necessary to prevent further open dumping. Any gates shall be kept locked.

b. A permanent sign shall be posted at the dump entrance indicating that it is closed, specifying the penalty for unauthorized dumping, identifying the location of a permitted site and providing other pertinent information.

c. Effective means shall be taken to eliminate flies and other insects, rodents, or vermin.

d. All fires shall be totally extinguished.

e. Extruding refuse shall be removed and the surface shall be permanently covered with earth.

f. Each dump shall be graded to promote runoff without erosion. Diversion drainage shall be provided as necessary to prevent surface water from entering the filled area.

g. The finished surface of the filled area shall be seeded with grasses or other suitable vegetation immediately upon completion or promptly in the spring on areas terminated during winter conditions.

h. The restored area shall be periodically cleaned up as needed to prevent it from reverting to an open dump.

i. Other corrective actions shall be taken as required by the executive director.

400—26.7(455B) Disruption and excavation of sanitary landfills or closed dumps. No person shall excavate, disrupt, or remove any deposited material from any active or discontinued sanitary landfill or closed dump without having first notified the department in writing.

26.7(1) Notification shall include an operational plan stating the area involved, lines and grades defining limits of excavation, estimated number of cubic yards of material to be excavated, sanitary disposal project where excavated material is to be disposed and estimated time required for excavation procedures.

26.7(2) An excavation shall be confined to an area consistent with the number of pieces of digging equipment and trucks used for haulage.

26.7(3) Adequate measures shall be taken during excavation to control dust, odors, fires, rodents, insects, and blowing litter.

26.7(4) The disposal of all solid waste resulting from excavation shall be in conformity with chapter 455B and these rules.

[Filed 9/1/74; amended 2/13/74, 6/2/75]

[Filed 2/25/77, Notice 9/22/76—published 3/23/77, effective 4/27/77]

CHAPTER 27
PERMITS

400—27.1(455B) Permit required. No public or private agency shall construct or operate a sanitary disposal project without first obtaining a permit from the executive director.

400—27.2(455B) Types of permits. There are three different types of permits issued by the executive director. These are described in this rule.

27.2(1) *Sanitary disposal project permit.* This permit is issued by the executive director under the authority of section 455B.79 of the Code for sanitary disposal projects which comply with the requirements described in chapters 28 through 31 of these rules. Such permits are issued for a term of three years, and are renewable for similar terms.

a. Applications for renewal to be timely filed must be received at the department's office at least sixty days before the expiration date of the existing permit. For application forms, see 32.1(2).

b. The department shall conduct an inspection of the sanitary disposal project following receipt of the application for renewal. Following the inspection, the permit holder shall be notified of all measures needed to bring the sanitary disposal project into conformance with chapter 455B and these rules.

c. A permit shall be renewed when a properly completed application has been received and all corrective measures required under 27.2(1)"*b*" have been completed.

27.2(2) *Temporary permit.* This permit is issued by the executive director under the authority of subsection 455B.82 (1) of the Code for solid waste disposal sites which do not comply with the requirements of chapter 455B of the Code and these rules. Such permits are nonrenewable, and shall not be issued for a term greater than one year.

a. Temporary permits shall incorporate as a condition a compliance schedule specifying how and when the applicant will meet the requirements for an operational sanitary disposal project.

b. The decision of the executive director whether to issue a temporary permit, being discretionary, shall be a final decision. Once a temporary permit has been issued, it may be suspended or revoked only as provided in section 455B.79 of the Code and chapter 55 of these rules.

27.2(3) *Developmental permit.* The executive director may issue a developmental permit for construction and operation of a sanitary disposal project which is not specifically described in these rules if the permit applicant demonstrates at a public hearing before the commission that the proposed project can provide satisfactory disposal of solid waste without adverse health related or environmental effects.

a. No such permit shall be issued until the commission, after public hearing, considers and approves the proposed project.

b. Developmental permits shall be issued for a term no less than one year and no more than three years.

c. Developmental permits may be renewed if the commission finds, following public hearing, that the sanitary disposal project provided satisfactory disposal of solid waste without adverse health related or environmental effects over the term of the prior permit.

400—27.3(455B) Application for permit. See rule 32.1(455B).

400—27.4(455B) Preparation of plans. All plans and specifications submitted in the application for a sanitary disposal project permit or a developmental permit shall be prepared in conformance with chapter 114 of the Code, and shall be submitted in triplicate.

400—27.5(455B) Construction and operation. All sanitary disposal projects shall be constructed and operated according to the plans and specifications as approved by the department and the terms of the permit. The approved plans and specifications shall constitute a term of the permit.

400—27.6(455B) Compliance with rule changes.

27.6(1) *Design and construction.* Sanitary disposal projects designed and constructed in accordance with rules in effect at the time of construction shall not be required to be redesigned or reconstructed due to subsequent rule changes unless the department finds that such facilities are causing land pollution. Such facilities shall be brought into compliance with rules in effect at the time of reconstruction, enlarging, or otherwise modifying the sanitary disposal project, or at the time of permit renewal.

27.6(2) *Operation.* If any new rule conflicts with an operating procedure prescribed in the engineering plans or the permit of a sanitary disposal project the operation shall conform with the new rule.

400—27.7(455B) Amendments. Permits may be modified by the issuance of an amendment by the department, except as provided in 27.6(1).

400—27.8(455B) Transfer of title and permit. If title to an operational sanitary disposal project is transferred, and the transferee desires to continue operation of the project, the transferee shall apply in writing to the department within thirty days of the transfer for a transfer of the permit.

27.8(1) The department shall transfer the permit when it determines that the sanitary disposal project is in compliance with chapter 455B of the Code and these rules and the terms of the permit, and that the transferee possesses the equipment and personnel to operate the project in conformance with chapter 455B and these rules and the terms of the permit.

27.8(2) No permit is valid after sixty days following transfer of title, unless the permit has been transferred by the department to the new title holder pursuant to this rule.

400—27.9(455B) Permit conditions. Any permit may be issued subject to conditions specified in writing which are necessary to insure the sanitary disposal project can be constructed and operated in compliance with these rules.

400—27.10(455B) Effect of revocation. If a permit held by any public or private agency for a sanitary disposal project is revoked by the commission, no new permit shall be issued to that agency for that disposal project for a period of one year from the date of revocation. This shall not prohibit the issuance of a permit for the disposal project to another public or private agency.

400—27.11(455B) Inspection prior to start-up. The department shall be notified when the initial construction of a sanitary disposal project has been completed, in order that an inspection may be made to determine that the project is constructed as designed. No solid waste shall be accepted by a sanitary disposal project until that project has been inspected and approved by the department.

400—27.12(455B) Primary plan requirements for all sanitary disposal projects. Every application for any permit issued by the department shall include the following. In addition, every application shall include the particular information required by the chapter describing the type of project to be constructed.

27.12(1) The name, address and telephone number of:
a. Owner of site where project will be located.
b. Permit applicant.
c. Official responsible for operation of project.
d. Design engineer.
e. Agency to be served by the project, if any.
f. Responsible official of agency served, if any.

27.12(2) A legal description of the site.

27.12(3) A map or aerial photograph locating the boundaries of the site and identifying:
a. North or other principal compass points.
b. Zoning and land use within one-half mile.
c. Haul routes to and from the site with load limits or other restrictions.
d. Homes and buildings within one-half mile.
e. Section lines or other legal boundaries.

27.12(4) Type, source, and expected volume or weight of waste to be handled per day, week or year.

27.12(5) An organizational chart and personnel manning table.

27.12(6) A detailed description of the disposal process to be used.

27.12(7) A table listing the equipment to be used, its design capacities and expected loads.

27.12(8) A contingency plan detailing specific procedures to be followed in case of equipment breakdown, maintenance downtime, or fire in equipment or vehicles, including methods to be used to remove or dispose of accumulated waste.

27.12(9) Detailed engineering drawings of the site showing all initial and permanent roads, buildings and equipment to be installed; unloading and holding areas; fences and gates; landscaping and screening devices; personnel and maintenance facilities; sewer and water lines.

27.12(10) Proof of the applicant's ownership of the site or legal entitlement to use the site for the disposal of solid waste for the term of the permit for which application is made.

27.12(11) Such other information as may be required by the executive director.

400—27.13(455B Operating requirements for all sanitary disposal projects. Every application for any permit issued by the department shall detail the means by which the following operating requirements shall be complied with. All sanitary disposal projects shall be operated in conformance with these requirements.

27.13(1) Open burning shall be prohibited except when permitted by the rules of the Iowa air quality commission. Any burning to be conducted at the site shall be at a location separate and distinct from the operating area.

27.13(2) Solid waste shall be unloaded at the operating area only when an operator is on duty at that area. Solid waste may be deposited in storage containers inside the site under the supervision of an attendant or operator.

27.13(3) The operating area for solid waste shall be as small as practicable and shall be surrounded with appropriate barriers to prevent litter from blowing beyond the operating area.

27.13(4) At the conclusion of each day of operation, any litter strewn beyond the confines of the operating area shall be collected and stored in covered leakproof containers or properly disposed.

27.13(5) Scavenging shall be prohibited. Any salvaging to be conducted must be described in the permit application and all salvaged materials must be stored and removed from the sanitary disposal project site in conformance with the permit conditions.

27.13(6) Effective means shall be taken to control flies, other insects, rodents and other vermin.

27.13(7) Equipment designated in the plans and specifications or equivalent equipment shall be used to operate the site at all times.

27.13(8) The major internal roads shall be of all weather construction and maintained in good condition. Dust shall be controlled on internal roads.

27.13(9) Telephone or other adequate communications facilities shall be available on the site.

27.13(10) Sanitary facilities, personnel washing facilities and potable water shall be available within a shelter on the site.

27.13(11) The site shall be fenced to control access and a gate shall be provided at the entrance to the site and kept locked when an attendant or operator is not on duty.

27.13(12) A copy of the permit, engineering plans, and specifications shall be kept at the site at all times.

27.13(13) Sites open to the public shall have a permanent sign posted at the site entrance specifying:

a. Name of the operation.
b. The site permit number.
c. The hours and days the site is open to the public.
d. The categories of waste which will be accepted for disposal or, as an alternative, identifies the categories of waste which are prohibited.
e. Telephone number of official responsible for the operation.

27.13(14) Sites not open to the public shall have a permanent sign posted at the site entrance specifying:

a. Name of the operation.
b. The site permit number.
c. That the site is not open to the public.
d. The owner's name and telephone number.

400—27.14(455B) Disposal of special wastes.

27.14(1) *Radioactive waste.* Radioactive materials shall not be disposed of by a sanitary disposal project. Luminous time pieces are exempt.

27.14(2) *Industrial sludge and toxic and hazardous waste.* No industrial sludge or toxic and hazardous waste shall be delivered to nor disposed by a sanitary disposal project unless explicit instructions are first obtained from the department.

a. For procedure see **rule 32.2(455B)**.

b. Prior to the issuance of any such instructions, the department may require that a proposal for disposal of such waste in conformance with these rules, with supporting data as may be deemed necessary, be submitted by the originator of such waste for evaluation by the department. The prohibition of such waste shall continue in effect until an acceptable procedure for processing or disposal has been developed and approved.

c. All toxic or hazardous waste or industrial sludge for which instructions have been received shall be disposed according to those instructions.

27.14(3) *Sewage sludge.*

a. Unstabilized sewage sludge, including septic tank pumpings, shall not be disposed at a sanitary landfill. Stabilized sewage sludge may be disposed of at a sanitary landfill as provided in chapter 28.

b. Stabilized and unstabilized sewage sludge may be handled at processing facilities as provided in chapter 29.

[Filed 2/25/77, Notice 9/22/76—published 3/23/77, effective 4/27/77]

CHAPTER 28
SANITARY LANDFILLS

400—28.1(455B) Scope and applicability. This chapter details the plan and operating requirements for all sanitary landfills. There are general requirements applicable to any type of sanitary landfill, and specific requirements for each of the types of sanitary landfills classified by the department. All sanitary landfills must conform with the provisions of chapter 27 of these rules, the general requirements set out in 28.2(455B), and the specific requirements set out in this chapter for the type of sanitary landfill to be established.

400—28.2(455B) General requirements for all sanitary land fills.

28.2(1) *Plan requirements.* The plans for all sanitary landfills shall include the following:

a. The map and aerial photograph required in 27.12(3) shall be of sufficient scale to show all homes, buildings, lakes, ponds, watercourses, wetlands, dry runs, rock outcroppings, roads and other applicable details including topography and drainage patterns. All wells shall be identified on the map or aerial photograph and a bench mark shall be indicated.

b. A plot drawing in appropriate scale of the site and the immediately adjacent area showing dimensions, topography with appropriate contour intervals, drainage patterns, known existing drainage tiles, locations where any geologic samples were taken, all water wells with their uses, and present and planned pertinent features including but not limited to roads, fencing, and cover stockpiles.

c. A drawing of the scheme of development including any excavation, trenching, and fill shown progressively with time. The methods to be used to insure compliance with the scheme and to provide vertical and horizontal controls shall be described.

d. Cross-sectional drawings showing progressively with time the original and proposed elevation of excavating, trenching, and fill.

e. Evidence that the proposed plan has been reviewed by the local soil conservation district commissioner and that the technical assistance of the soil conservation district will be utilized to facilitate compliance with wind and water soil loss limit regulations provided for in sections 467A.42 to 467A.51 of the Code.

f. An ultimate land use proposal, including intermediate use stages, with time schedules indicating the total and complete land use. Final elevations, grades, permanent drainage structures, monitoring or treatment facilities and permanent improvements of the completed landfill shall be included. Any supporting drawings to the ultimate land use proposal shall be in appropriate scale.

g. Information describing:

(1) Source, volume, and characteristics of cover material

(2) Area of site in acres

(3) Areas to be used for salvaging and the burning of diseased trees.

h. A report consisting of information verifying that the portion of the site to be filled is:

(1) So situated as to obviate any predictable lateral movement of significant quantities of leachate from the site to standing or flowing surface water or to shallow aquifers that are in actual use or are deemed to be of potential use as a water resource.

(2) So situated that the base of the proposed site is at least five feet above the high water table unless a greater separation is required to ensure that there will be no significant adverse effect on ground or surface waters or a lesser separation is unlikely to have a significant adverse effect on ground and surface waters.

(3) Outside a flood plain or shoreland, unless proper engineering and sealing of the site will render it acceptable and prior approval of the Iowa natural resources council and where necessary the U.S. Corps of Engineers is obtained.

(4) So situated to assure no adverse effect on any well within 1000 feet of the site existing at the time of application for the original permit which is being used or could be used without major renovation for human or livestock consumption or at least 1000 feet from any such well

unless hydrologic conditions are such that a greater distance is required to assure there is no adverse effect on the well.

(5) So situated to assure no adverse effect on the source of any community water system in existence at the time of application for the original permit within one mile of the site or at least one mile from the source of any community water system in existence at the time of application for the original permit unless hydrologic conditions are such that a greater distance is required to assure no adverse effect on the water system.

(6) At least twenty feet from the adjacent property line unless there is a written agreement with the owner of the abutting property. For new permit applications and associated reports submitted after April 27, 1977, the report shall verify that the portion to be filled is at least 50 feet from the adjacent property line. The written agreement shall be filed with the county recorder and shall become a permanent record of the property.

(7) Beyond 500 feet from any existing habitable residence unless there is written agreement with the owner of the residence and the site is screened by natural objects, plantings, fences or by other appropriate means. The residence must be in existence on the date of application for the original permit from the department. The written agreement shall be filed with the county recorder and recorded for abstract of title purposes, and a copy submitted to the department.

i. Should conditions in violation of 28.2(1)"*h*" (1), (2), (3), (4), or (5) exist, the original plan shall detail how the site is to be engineered to provide equivalent protection to the water resources. The applicant shall have the burden of showing that equivalent protection will be provided.

j. If stabilized sewage sludge is to be disposed at the site, the characteristics of the sludge and the method of disposal shall be described. If sludge is to be disposed by land application, it shall be in conformance with 28.2(1)"*k*".

k. If stabilized sewage sludge is to be land applied at the site, a report including the following information shall be submitted.

(1) Verification that the portion of the site on which the sludge will be applied is at least 500 feet from any well in existence at the time of application for the original permit, which is being used or could be used without major renovation for human or livestock consumption and which draws from an aquifer that underlies the site, unless conditions are such that a greater distance is required to assure that there is no adverse effect on the water supply or a lesser distance can be permitted without adverse effect on the water supply.

(2) Verification that the portion of the site on which the sludge will be applied is at least 200 feet from the nearest habitable residence.

l. Such additional data and information as may be deemed necessary by the executive director to evaluate a proposed sanitary landfill.

28.2(2) *General operating requirements for all sanitary landfills.* All sanitary landfills shall be operated in conformance with this subrule. The plan submitted shall detail how the sanitary landfill will comply with these requirements.

a. Solid waste shall not be deposited in such a manner that material or leaching therefrom may cause pollution of ground or surface waters.

b. Provisions shall be made to have cover material available for winter and wet weather operations.

c. Each site shall be graded and provided with drainage facilities to minimize the flow of surface water onto and into the portion of the site to be filled and to prevent soil erosion and ponding of water.

d. The finished surface of the site shall be repaired as required, covered with soil, and seeded with native grasses or other suitable vegetation immediately upon completion or promptly in the spring on areas terminated during winter conditions. If necessary, seeded slopes shall be covered with straw or similar material to prevent erosion.

e. As required by the executive director, monitoring wells shall be drilled and samples from these analyzed by a laboratory which is equipped and competent to perform the tests required by the executive director. The results shall be forwarded to the department on a stipulated schedule.

f. In the event significant leachate is detected, the department shall be so notified, and the permit holder shall submit a plan for controlling and treating the leachate. Upon approval of the plan by the department, it shall be immediately implemented.

g. Prior to completion of a site, or suspension of operations at a site, the executive director shall be notified in writing. An inspection shall be made by the executive director before earthmoving equipment is removed from the site.

h. For five years following closing of the site, repairs shall be made as necessary to assure integrity of the final cover and to maintain the desired finished slopes. An annual report specifying the repairs made shall be submitted to the executive director.

i. A copy of the original plans and specifications, along with pertinent operational data, for any completed sanitary disposal project used for the disposal of solid waste shall be filed with the county recorder and the location of the filled area shall be recorded for abstract of title purposes. Such recording may be made by affidavit.

400—28.3(455B) Specific requirements for a sanitary landfill proposing to accept all solid waste except toxic or hazardous waste.

28.3(1) *Plan requirements.* The plans for sanitary landfills proposing to accept all solid waste except toxic or hazardous waste shall include the following information in addition to that required by chapter 27 and subrule 28.2(1).

a. A description of the material underlying the proposed site including stratigraphic sections based on a number of borings adequate to accurately determine the geology of the proposed site unless the department agrees that an equivalent description may be obtained without borings. Additional information, including supplemental borings may be required for any additional locations of specific concern to the department.

(1) The stratigraphic sections shall be described from the surface to and including at least five feet of the uppermost bedrock unit or to a depth of at least fifty feet unless conditions are such that a greater depth may be required or a lesser depth has been agreed to by the executive director.

(2) Each soil layer shall be described in terms of Atterberg limits and grain size distribution by means of field identification and laboratory seive and hydrometer analysis, unless the department agrees that other data will provide equivalent information.

(3) Samples of sediments and rock units shall be collected at five-foot intervals or when different soil layers are encountered, whichever is more frequent, unless the department agrees that other data will provide equivalent information. If samples are required, they shall be identified by location and depth. The name of the person classifying the sediments shall be indicated. One complete set of unaltered sack samples shall be submitted with the application. A drilling location plan and drilling log shall be submitted for each series of samples.

b. The general direction of groundwater flow and the number, location, and depth of monitoring wells needed to monitor groundwater quality.

c. Information indicating that the portion of the landfill site to be filled is not situated in an unconsolidated sequence that will permit more than 0.004 cubic foot of liquid per day per square foot of area downward leakage into the groundwater beneath or adjacent to the proposed site.

(1) The potential downward leakage shall be evaluated by means of the generalized Darcy's law $Q = P \frac{(h_2 - h_1)}{L} A$ where:

Q = feet of liquid /day/square foot of area of the interface
A = one square foot of area at the base of the landfill
P = coefficient of permeability of the unconsolidated confining unit above the high water table
h_2 = maximum final elevation of a contiguous portion of fill of the site
h_1 = lowest elevation of the top of the confining unit above the high water table
L = minimum thickness of the confining unit above the high water table

(2) Should conditions in violation of this paragraph exist, the original plan must detail how the site is to be engineered to provide equal protection to the water resources.

28.3(2) *Specific operating requirements for sanitary landfills proposing to accept all solid waste except toxic or hazardous waste.* Sanitary landfills accepting all solid waste shall be operated in conformance with chapter 27, subrule 28.2(2), and this subrule. The plan submitted shall detail how the sanitary landfill will comply with these requirements.

a. Immediately after solid waste is deposited, it shall be uniformly spread and compacted as densely as practicable in layers not exceeding two feet in depth and at an operating face slope which will permit thorough compaction into cells.

b. Solid waste at the site shall be covered after each day of operation with a compacted layer of at least six inches of earth. In no event shall solid waste be exposed for more than twenty-four hours.

c. At least one foot of intermediate cover of compacted earth shall be applied to any area of the site which will not be utilized for further disposal of solid waste for more than one week.

d. At least a two foot cover of compacted earth shall be applied to any area of the site which will not be utilized for further disposal of solid waste for more than two months. The cover shall be graded to allow surface water runoff.

e. The final cover shall be consistent with the proposed land use, but in no event shall be less than two feet.

400—28.4(455B) Specific requirements for a sanitary landfill proposing to accept only construction and demolition waste.

28.4(1) *Plan requirements.* The plans for sanitary landfills proposing to accept only construction and demolition waste shall include the following information in addition to that required by chapter 27 and subrule 28.2(1).

a. A description of the material underlying the proposed site, including a stratigraphic section based on at least one boring, unless the department agrees that an equivalent description may be obtained without borings. Additional information, including supplemental borings, may be required for any additional locations of specific concern to the department.

(1) The stratigraphic section shall be described from the surface to a depth of two feet below the water table or to and including at least five feet of the uppermost bedrock unit.

(2) Each soil layer shall be described in terms of Atterberg limits and grain size distribution by means of field identification and laboratory seive and hydrometer analysis, unless the department agrees that other data will provide equivalent information.

(3) Samples of sediments and rock units shall be collected at five-foot intervals or when different soil layers are encountered, whichever is more frequent, unless the department agrees that other data will provide equivalent information. If samples are required, they shall be identified by location and depth. The name of the person classifying the sediments shall be indicated. One complete set of unaltered sack samples shall be submitted with the application. A drilling location plan and drilling log shall be submitted for each series of samples.

b. Information indicating that the portion of the landfill site to be filled is not situated in an unconsolidated sequence that will permit more than 0.1 cubic foot of liquid per day per square foot of area downward leakage into the groundwater beneath or adjacent to the proposed site.

(1) The potential downward leakage shall be evaluated by means of the generalized Darcy's Law $Q = P \frac{(h_2 - h_1)}{L} A$ where:

Q = feet of liquid/day/square foot of area of the interface
A = one square foot of area at the base of the landfill
P = coefficient of permeability of the unconsolidated confining unit above the high water table

h_2 = maximum final elevation of a contiguous portion of fill of the site
h_1 = lowest elevation of the top of the confining unit above the high water table
L = minimum thickness of the confining unit about the high water table.

(2) Should conditions in violation of this paragraph exist, the original plan must detail how the site is to be engineered to provide equal protection to the water resources.

28.4(2) *Specific operating requirements for sanitary landfills proposing to accept only construction and demolition waste.* Sanitary landfills accepting only construction and demolition waste shall be operated in conformance with chapter 27, subrule 28.2(2), and this subrule. The plan submitted shall detail how the sanitary landfill will comply with these requirements.

a. Immediately after solid waste is deposited, it shall be uniformly distributed and compacted as densely as practical.

b. The waste shall be covered with a minimum of one foot of earth at least once every seven days of operation. The day during which cover will be applied shall be specified in the plan.

c. At least a two-foot cover of compacted earth shall be applied to any area of the sanitary landfill which will not be utilized for further disposal of solid waste for more than two months. The cover shall be graded to allow surface water runoff.

d. The final cover shall be consistent with the proposed land use but in no event shall be less than two feet.

400—28.5(455B) Specific requirements for a sanitary landfill proposing to accept a specific type of solid waste.

28.5(1) *Plan requirements.* The plans for sanitary landfills proposing to accept only a specific type of solid waste shall include the following information in addition to that required by chapter 27 and subrule 28.2(1).

a. The source of the solid waste and a description of the process which produces it.

b. A detailed analysis of the solid waste to be deposited at the site, including such tests as may be required by the executive director to evaluate the potential impact of disposal of the solid waste on the environment if it is disposed in the manner described in the plans.

c. A description of the material underlying the proposed site, including stratigraphic sections based on a number of borings adequate to accurately determine the geology of the proposed site, unless the department agrees that an equivalent description may be obtained without borings. Additional information including supplemental borings may be required for any additional locations of specific concern to the department.

(1) The stratigraphic sections shall be described from the surface to a depth determined by the executive director necessary to evaluate the suitability of the site for disposal of the specific waste.

(2) Each soil layer shall be described in terms of Atterberg limits and grain size distribution by means of field investigation and laboratory seive and hydrometer analysis unless the department agrees that other data will provide equivalent information.

(3) Samples of sediments and rock units shall be collected at five-foot intervals or when different soil layers are encountered, whichever is more frequent unless the department agrees that other data will provide equivalent information. If samples are required, they shall be identified by location and depth. The name of the person classifying the sediments shall be indicated. One complete set of unaltered sack samples shall be submitted with the application. A drilling location plan and drilling log shall be submitted for each series of samples.

d. The direction of groundwater flow and the number, location, and depth of monitoring wells needed to monitor the groundwater quality.

e. Information indicating that the portion of the landfill site to be filled is not situated in an unconsolidated sequence that will permit leakage of a quantity or quality reasonably likely to have an adverse effect on the groundwater beneath or adjacent to the proposed site. The potential downward leakage shall be evaluated by means of the generalized Darcy's Law $Q = P \frac{(h_2 - h_1)}{L} A$ where:

Q = feet of liquid/day/square foot of area of the interface
A = one square foot of area at the base of the landfill
P = coefficient of permeability of the unconsolidated confining unit above the high water table
h_2 = maximum final elevation of a contiguous portion of fill of the site
h_1 = lowest elevation of the top of the confining unit above the high water table
L = minimum thickness of the confining unit above the high water table

f. Engineering detailing how the site will be designed, constructed, and operated to protect ground and surface water resources.

g. If the information submitted in 28.5(1)"*b*" indicates that no danger of contamination of ground or surface waters exists, the executive director may waive any rule requiring analysis and definition of the subsurface geology.

28.5(2) ***Specific operating requirements for sanitary landfills proposing to accept a specific type of solid waste.*** The operating requirements for a sanitary landfill accepting a specific type of solid waste will necessarily vary with the nature of the solid waste. Accordingly, no single standard of operation is practical. The applicant shall submit a plan of operation which incorporates the requirements of chapter 27 and subrule 28.2(2), and which proposes minimum standards to be maintained at the site for the following operating procedures. The executive director shall approve the proposed standards if he finds they will provide adequate protection of the environment. The sanitary landfill shall be operated in conformance with chapter 27, subrule 28.2(2) and the standards approved by the executive director.

a. Daily, intermediate, and final cover.
b. Number and duties of personnel.
c. Storage and preliminary processing of solid waste.
d. Safety procedures and equipment.
e. Operating equipment.
f. Buildings and shelter.

[Filed 9/1/71; amended 2/13/74]
[Filed 2/25/77, Notice 9/22/76—published 3/23/77, effective 4/27/77]

CHAPTER 29
SANITARY DISPOSAL PROJECTS WITH PROCESSING FACILITIES

400—29.1(455B) Scope and applicability. Any sanitary disposal project utilizing any of the equipment described in this chapter shall comply with the requirements for that equipment set out in this chapter, in addition to the requirements of chapter 27.

29.1(1) Detailed engineering drawings of the sanitary disposal project shall be submitted showing all conveyor lines, holding areas, loading and unloading areas, transfer points, and lines of flow for all waste and salvaged materials.

29.1(2) Design specifications for all equipment shall be as follows:

a. All equipment which may be cleaned by washing shall be installed on reasonably smooth impermeable floors so designed as to be easily cleaned and having drainage to a sanitary sewer unless other acceptable provisions are made to control process or wash water.

b. All equipment shall be so designed as to prevent spilling of waste and to be easily cleaned and shall be adequately enclosed so as to prevent blowing of dust or litter or wetting of the waste from precipitation or runoff.

400—29.2(455B) Dumping or holding floors or pits.

29.2(1) All unloading area surfaces shall be constructed of impervious, reasonably smooth material so designed as to be easily cleaned, with drainage to a sanitary sewer.

29.2(2) All unloading areas shall have a storage capacity of at least one day's processing capacity.

29.2(3) All unloading areas shall be adequately enclosed and roofed so as to prevent blowing of dust or litter and to prevent precipitation or drainage onto any accumulated waste.

29.2(4) Dumping pits shall have curbs or tie downs adequate to prevent vehicles from falling into the pit.

400—29.3(455B) Compaction equipment. All compactors shall be located on reasonably smooth impermeable aprons so designed as to control wash water and area runoff, be easily cleaned, and avoid creation of fly or rodent habitats.

400—29.4(455B) Hammermills.

29.4(1) All hammermills shall be equipped with adjustable water spray or other dust suppression equipment.

29.4(2) All hammermills shall be provided with fire and explosion control or suppression devices or equipment.

29.4(3) Solid waste which cannot be processed by the hammermill or is rejected by it shall be stored in enclosed leakproof containers.

400—29.5(455B) Hydropulping or slurrying equipment. All solid waste which cannot be processed by such equipment or is rejected by it shall be stored in enclosed leakproof containers.

400—29.6(455B) Air classifiers. All air classifiers shall be equipped with dust suppression equipment unless air is recirculated.

400—29.7(455B) Metals separation equipment.

29.7(1) Metals separation equipment shall be installed at that point in the process which minimizes possible organic contamination of the metal.

29.7(2) Provisions shall be made for storage of separated materials in enclosed leakproof containers.

400—29.8(455B) Sludge processing.

29.8(1) If introduced to solid waste, sludges shall be introduced after any resource recovery operation.

29.8(2) Sludge addition equipment and storage facilities shall be sanitary and odor free.

400—29.9(455B) Storage containers and facilities.

29.9(1) *Storage of solid waste.*

a. Containers used for the storage of all solid wastes except salvaged materials but including refuse derived fuels shall be covered, leakproof, durable and of easily cleanable construction.

b. Facilities used for the storage of all solid wastes except salvaged materials but including refuse derived fuels shall be constructed as follows:

(1) Storage facilities shall have a smooth, impervious, easily cleaned base.

(2) Storage facilities shall provide leachate collection.

(3) Storage facilities shall prevent runoff entering the facility from adjacent areas.

(4) Storage facilities, except for compost storage facilities, shall be enclosed to prevent blowing litter and roofed to prevent precipitation into any solid waste.

29.9(2) *Storage of salvaged materials.* Containers and facilities used for the storage of salvaged materials shall be designed and constructed to prevent odor, litter, leaching and vector problems. The acceptability of any such container shall be based on the materials being stored, duration of storage and conditions to be experienced.

400—29.10(455B) Operating requirements for all processing facilities. All sanitary disposal projects with processing facilities shall be operated in conformance with chapter 27 and this subrule. The plan submitted shall detail how the facility will comply with these requirements.

29.10(1) All equipment shall be cleaned daily unless the department approves less frequent cleaning on a specific schedule stipulating component part, cleaning method, and schedule.

29.10(2) Sewage sludge shall not be handled in such a manner as to present a health hazard or potential source of pollution.

29.10(3) All solid waste processed or rejected by the facility shall be disposed in conformance with these rules.

29.10(4) Sites with storage containers or facilities for composted materials shall be monitored for leachates and records shall be maintained of leachate generation, precipitation and storage duration.

29.10(5) Emergency access shall be provided to the material in solid waste storage facilities.

29.10(6) Composted material shall be identified by markers in the storage area.

29.10(7) Storage time.

a. Solid waste. Solid waste, except for composted materials, but including refuse derived fuels shall not be stored on the site for more than seventy-two hours.

b. Composted material. Composted materials shall not be stored on the site for more than sixty days.

[Filed 9/1/71, amended 2/13/74, 6/2/75]
[Filed 2/25/77, Notice 9/22/76—published 3/23/77, effective 4/27/77]

CHAPTER 30
COMPOSTING FACILITIES

400—30.1(455B) Specific design requirements. The plans required in rule 27.12(455B) shall include a detailed description of the operation including:

30.1(1) Method of composting.

30.1(2) Duration of composting.

30.1(3) Method of removal of composted materials.

30.1(4) Final disposition of the composted materials.

400—30.2(455B) Specific operating requirements for all composting facilities. All composting facilities shall be operated in conformance with chapter 27, chapter 29 and this subrule. The plans required in 27.13(455B) shall detail the means by which the following operating requirements shall be complied with.

30.2(1) Composted materials shall be immediately removed from the site unless approved storage facilities are provided.

30.2(2) Tests to monitor the operation and define stability shall be made by the operator as required by the executive director. These tests shall include but not be limited to the following:

a. Temperature of waste.

b. Percent moisture content of waste.

c. Volume of waste.

d. Density of waste.

e. Ambient temperature.

30.2(3) Materials resulting from composting or similar processes and offered for sale shall contain no pathogenic organisms, shall be innocuous and shall contain no sharp particles which would cause injury to persons handling the compost. Sale shall be in compliance with all applicable federal and state laws and local ordinances and regulations.

30.2(4) Solid waste which cannot be composted or which is removed during processing shall be handled in a manner which will not create pollution or a nuisance, and shall be disposed by another method provided in these rules.

[Filed 9/1/71; amended 2/13/74]
[Filed 2/25/77, Notice 9/22/76—published 3/23/77, effective 4/27/77]

CHAPTER 31
RECYCLING OPERATIONS

400—31.1(455B) Specific design requirements. The plans required in 27.12(455B) shall include a complete description of the method of processing reclaimed salvageable materials, the disposition of such materials, the transfer points to which they will be moved, capacities of such points, and frequency of interchange shall be shown.

400—31.2(455B) Specific operating requirements for all recycling operations. The plans required in 27.12(455B) shall detail the means by which the following requirements will be complied with. Material which cannot be recycled or removed during processing shall be handled in a manner which will not create pollution or a nuisance and shall be disposed of by another method provided in these rules.

400—31.3(455B) Recycling operations processing paper, cans and bottles. Recycling operations which handle only paper, cans, and bottles are exempt from 31.1(455B) and 31.2(455B), and chapter 27 and 29 if the operation has no mechanical processing facilities or if the operation receives on average less than two tons of paper, cans, and bottles per day. Such operations shall submit the following information to the department for distribution to the public; address or legal description of site, organization operating the facility, name and phone number of the responsible official of the facility, type of waste to be handled, operating days and hours.

[Filed 9/1/71; amended 2/13/74]
[Filed 2/25/77, Notice 9/22/76—published 3/23/77, effective 4/27/77]

CHAPTER 32
RULES OF PRACTICE

400—32.1(455B) Applications for permits and renewals. Any private or public person or agency desiring to secure any permit or renewal thereof provided for in chapter 455B, division IV, part 1 of the Code, or the rules promulgated pursuant thereto, shall file a properly completed application with the land quality management division of the department.

32.1(1) A properly completed application shall consist of the application form with all blanks filled in by the applicant, all signatures, and all documents and information required by the solid waste disposal rules. Application forms may be obtained from, and properly completed forms shall be submitted to:

Chief, Permits Section
Land Quality Management Division
Department of Environmental Quality
3920 Delaware Avenue, P.O. Box 3326
Des Moines, Iowa 50316

32.1(2) Application for the following permits or renewals shall be made in triplicate on the forms indicated:

a. A sanitary disposal project permit pursuant to section 455B.79 of the Code—Form LQ-25.

b. A temporary permit pursuant to subsection 455B.82(1) of the Code as amended by the 66th General Assembly, Chapter 59—Form LQ-26.

c. A renewal of a sanitary disposal project permit pursuant to rule 26.1(455B)—Form LQ-28.

32.1(3) Rescinded April 27, 1977.

32.1(4) It is strongly recommended that applicants contact the department before engineering plans are drafted, to insure that the requirements of the rules are understood and to discuss any special problems of the proposed project.

400—32.2(455B) Hazardous and toxic waste instructions. Requests for instructions for the disposal of hazardous or toxic waste, as required by 26.4(4) shall be submitted to:

Compliance and Surveillance Section
Land Quality Management Division
Department of Environmental Quality
3920 Delaware Avenue, P.O. Box 3326
Des Moines, Iowa 50316

32.2(1) Requests shall be made in writing, where possible. In case of emergency, instructions may be obtained by phone at 515/265-8134.

32.2(2) Requests, whether written or oral, shall include the following information: Chemical composition of the waste, physical form of the waste, volume of the waste to be disposed, any problems associated with any toxic or hazardous component of the waste, and any other information deemed necessary by the department.

32.2(3) Instructions issued shall only apply to the disposal of the particular waste described in the request at the sanitary disposal project requesting instructions. If the sanitary disposal project requesting instructions desires to accept additional equivalent volumes of that particular waste on a regular basis, the department may authorize such regular disposal in its instructions.

400—32.3 Rescinded April 27, 1977.

400—32.4(455B) Review hearings and appeals.

32.4(1) *Contested cases.* The following are contested cases, and all procedures relating to such cases shall be as prescribed in chapter 55 of the rules of the department:

a. The appeal of an order of the executive director pursuant to section 455B.83 of the Code;

b. The appeal of the denial of a sanitary disposal project permit or denial of renewal of such permit, but not a temporary disposal permit. The applicant may deem any condition of a permit imposed by the department as a denial of the permit for purposes of this paragraph.

c. The hearing on the suspension or revocation of any sanitary disposal project permit pursuant to section 455B.79;

d. The hearing on a notice of violation pursuant to section 455B.90;

e. The hearing on an emergency order pursuant to section 455B.91.

32.4(2) ***Denial of instructions for disposal of hazardous waste.*** If a request for instructions for the disposal of hazardous waste pursuant to 26.4(5) is denied by the department, the applicant may appeal to the solid waste disposal commission by filing a notice of appeal with the executive director within thirty days of the denial. The executive director shall then schedule a hearing at the next regular meeting of the solid waste disposal commission. The hearing shall be conducted informally by a hearing officer or the chairman of the commission in a manner which will allow the appellant and the department to present all information relevant to a proper determination of the matter. The decision of the commission shall be a final decision.

[Filed 12/19/75, Notice 9/8/75—published 1/12/76, effective 2/16/76]
[Filed emergency 3/1/76—published 3/22/76, effective 3/1/76]
[Filed 2/25/77, Notice 9/22/76—published 3/23/77, effective 4/27/77]

CHAPTERS 33 and 34
Reserved

TITLE V
CHEMICAL TECHNOLOGY

CHAPTER 35
AGRICULTURAL CHEMICALS

400—35.1(455B) Use of DDT AND DDD. Pesticides containing dichloro diphenyl trichloroethane (DDT) or dichloro diphenyl dichloroethane (DDD) shall not be distributed,

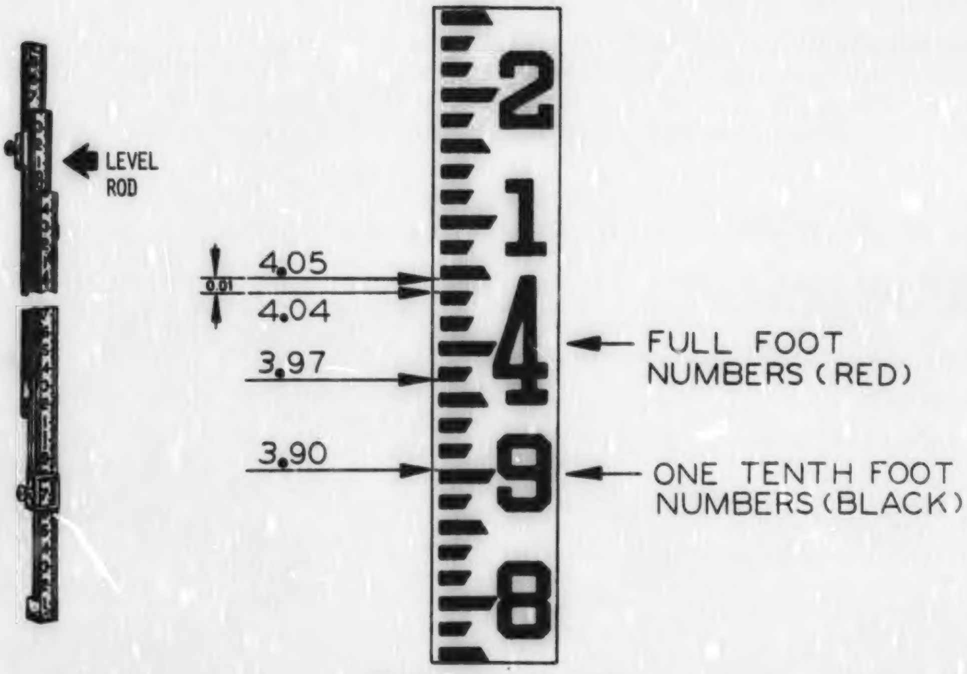
APPENDIX C
DETERMINATION OF ELEVATIONS

The following method can be used if you wish to determine the specific elevation of a point on your site. This may be needed if you wish to determine:

1. How close you are to the design
2. What your actual depth of cut is;
3. what your actual depth of fill is;
4. How close your fill is to the designed final elevations; or,
5. How much cover material you have used or have left, you may wish to use the following technique.

A hand level as shown in Chapter 11 may be accurate enough for most applications. In addition, a level rod (Figure D.1) is necessary to measure elevations.

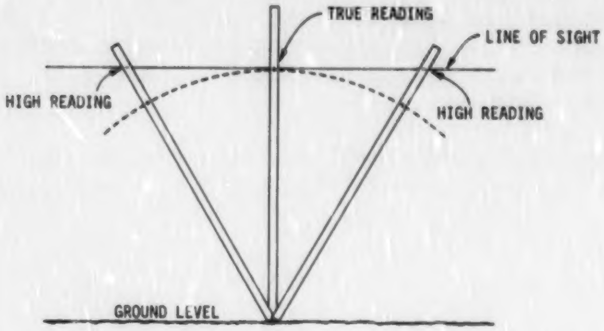
FIGURE D.1
A level rod


LEVEL ROD
4.05
0.01
4.04
3.97
3.90
2
1
4
9
8
FULL FOOT NUMBERS (RED)
ONE TENTH FOOT NUMBERS (BLACK)

READING A ROD

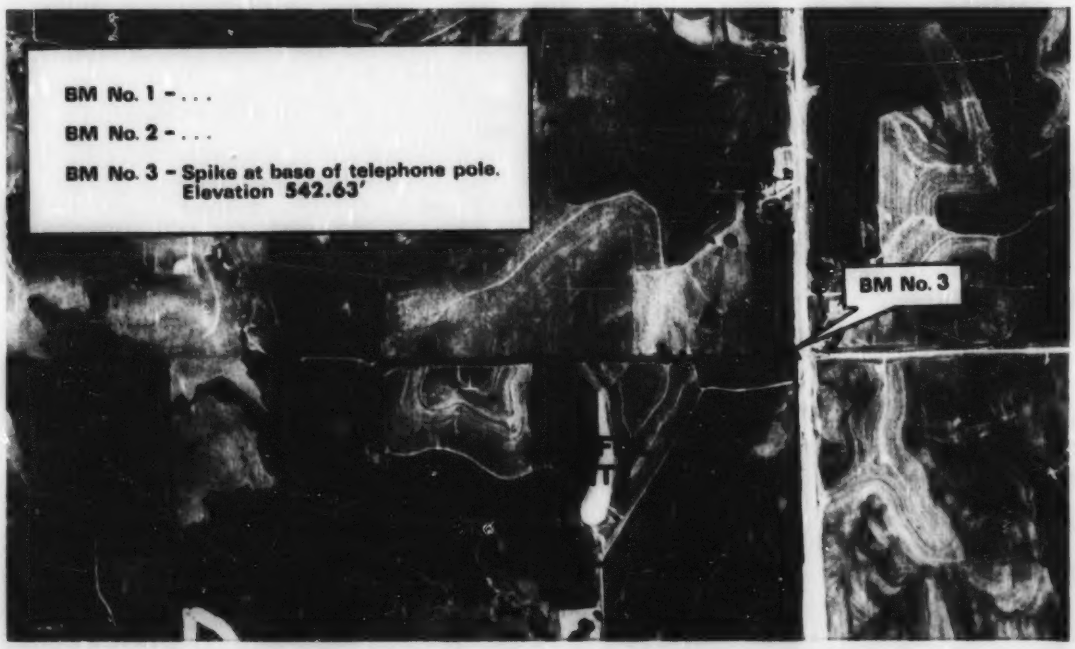
When viewing the level rod, the rodman must be sure the level is vertical, otherwise the level operator will get a high reading (Figure D.2). To avoid getting a high reading, the rod should be slowly waived back and forth until the true reading is given.

FIGURE D.2
Obtaining the true rod reading


TRUE READING
LINE OF SIGHT
HIGH READING
HIGH READING
GROUND LEVEL

Engineering plans for sanitary landfills have a benchmark noted on them. This is a permanent point which has been assigned an elevation, Figure D.3 shows part of a typical plan showing a benchmark which is a spike driven into the base of a telephone pole and assigned the benchmark elevation 542.63'.

FIGURE D.3
A typical bench mark identification on a set of plans


BM No. 1 - . . .
BM No. 2 - . . .
BM No. 3 - Spike at base of telephone pole. Elevation 542.63'
BM No. 3

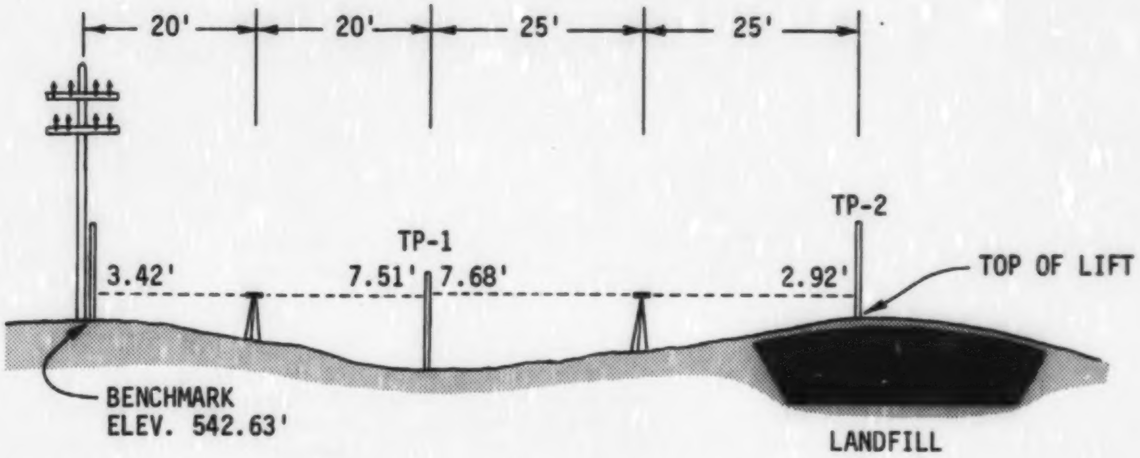
Before beginning the leveling operation, the benchmark should be located to get your reference elevation, And, a note sheet should be set up as shown in Figure D.4. The following example shows how it would be used.

FIGURE D.4
Layout of a surveyor's note sheet

STATION	+ S	HI	- S	ELEVATION	NOTES

Example: The engineering plans call for the final elevation of the lift to be 545.00'. You have filled up the trench and want to know how much higher you can go with the lift before you begin applying the final cover. Final cover is two feet thick. (Figure D.5)

FIGURE D.5
Finding the elevation of the top of a sanitary landfill trench


20'
20'
25'
25'
TP-1
TP-2
3.42'
7.51'
7.68'
2.92'
TOP OF LIFT
BENCHMARK
ELEV. 542.63'
LANDFILL

1. A two man crew is needed. A rodman and an instrument man.

2. The instrument man should set up a note sheet as illustrated in Figure D.6.

3. Study the sanitary landfill plans and locate the benchmark, which in this example is a spike at the base of a telephone pole. The benchmark elevation is 542.63. Assign the term "Station A" to the benchmark and record the benchmark elevation. (Notation (1), Figure D.6)

4. With the rodman holding the rod on the benchmark, the instrument man pace off 20 feet from the benchmark toward the fill area and sights the instrument. Read the rod reading of 3.42 feet and record 3.42 as a positive sight (+S) on Station A. (Notation (2), Figure D.6) The elevation is the benchmark elevation of 542.63. The height of instrument (HI) is 542.63 + 3.42 = 546.05. (Notation (3), Figure D.6)

FIGURE D.6
A completed note sheet

STATION	+S	HI	-S	ELEVATION	NOTES
A	3.42 ②	546.05 ③		542.63 *①	542.63+3.42=546.05
TP-1	7.68 ⑥	546.22 ⑦	7.51 ④	538.54 ⑤	546.05-7.51=538.54 538.54+7.68=546.22
TP-2			2.92 ⑧	543.30 ⑨	546.22-2.92=543.30

* The number in the circle corresponds to the sequence in which the numbers are filled in on the note sheet.

where: +S = plus sight (a rod reading taken on a turning point or other object whose elevation is to be determined. It is the vertical distance from the line of sight to the point observed.)

HI = height of instrument (the elevation of the line of sight.)

−S = minus sight (a rod reading taken on a turning point or other object whose elevation is to be determined. It is the vertical distance from the benchmark or turning point to the line of sight.)

5. The rodman should walk to the instrument and pace off an equal distance (in the example, 20 feet) in the opposite direction. Keeping the instrument at the same heighth the instrument man reads the rod at 7.51. Record 7.51 as the minus sight (-S) at turning point 1 (TP-1). (Notation (4), Figure D.6). Subtract the minus sight 7.51, from the (HI) 546.05, to get the ground elevation at the rod 546.05-7.51 = 538.54. (Notation (5), Figure D.6).

6. The instrument man should pace a distance from the rodman (in the example, 25 feet) and with the rodman holding the rod in place read 7.68 (Notation (6), Figure D.6). The height of the instrument is:

   538.54 + 7.68 = 546.22 (Notation (7), Figure D.6)

7. Repeating the procedure in step 5 but walking 25 feet gives a reading of 2.92 feet (Notation (8), Figure D.6). The ground elevation at TP2 is:

   546.22 - 2.92 = 543.30 (Notation (9), Figure D.6)

8. Since the plans call for the final elevation to be 545.00, the difference between the planned final elevation and the existing elevation is the amount of fill required to bring the earthwork up to final grade.

   Therefore: 545.00 - 543.30 = 1.70

   1.70 feet of soil will bring the elevation up to the designed final grade.

   The two foot final cover will bring you up to elevation:

   543.30 + 2.00 = 545.30

   which is 0.30 feet above the designed final grade.

APPENDIX D

CALCULATION OF EARTHWORK QUANTITIES

If you want to determine the amount of dirt that has to be moved or needs to be moved than the simplest method for calculating quantities is the "average end area" method. Calculations are made by using the average end area formula.

$$V = \tfrac{1}{2}(A_1+A_2)\ell\ (\text{ft.}^3)$$

$$= \tfrac{1}{2}(A_1+A_2)\ell\ (\text{ft.}^3)\ \frac{\text{yd.}^3}{27\ \text{ft.}^3}$$

$$= 1/54(A_1+A_2)\ell\ (\text{yd.}^3)$$

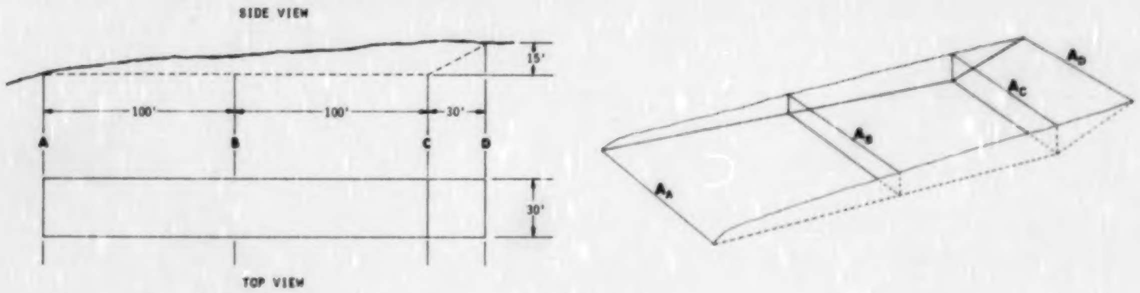
Where: V = volume of earth cut or filled

A_1 and A_2 = area of end sections in square feet

ℓ = length in feet

Example 1: A Trench is to be cut into the side of a sloping hill. (Figure E.1) Calculate the amount of soil cut from the trench to get an idea of the amount of cover material that will be available from the trench.

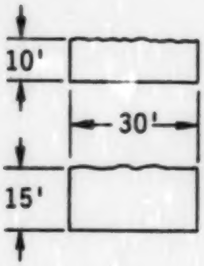
FIGURE E.1
Example trench to be excavated



1. Area Calculations

Area A = A_A = 0

Area B = A_B = 10 ft X 30 ft = 300 ft^2



Area C = A_C = 15 ft X 30 ft = 450 ft^2

Area D = A_D = 0

2. Volume Calculations

Using the formula on p. 1 of this Appendix:

The volume between A and B = V_{A-B} = 1/54 X (0 + 300) X 100 yd^3

= 1/54 X 300 X 100 yd^3 = 555.6 yd^3

The volume between B and C = V_{B-C} = 1/54 X (300 + 450) X 100 yd^3

= 1/54 X 750 X 100 yd^3 = 1388.9 yd^3

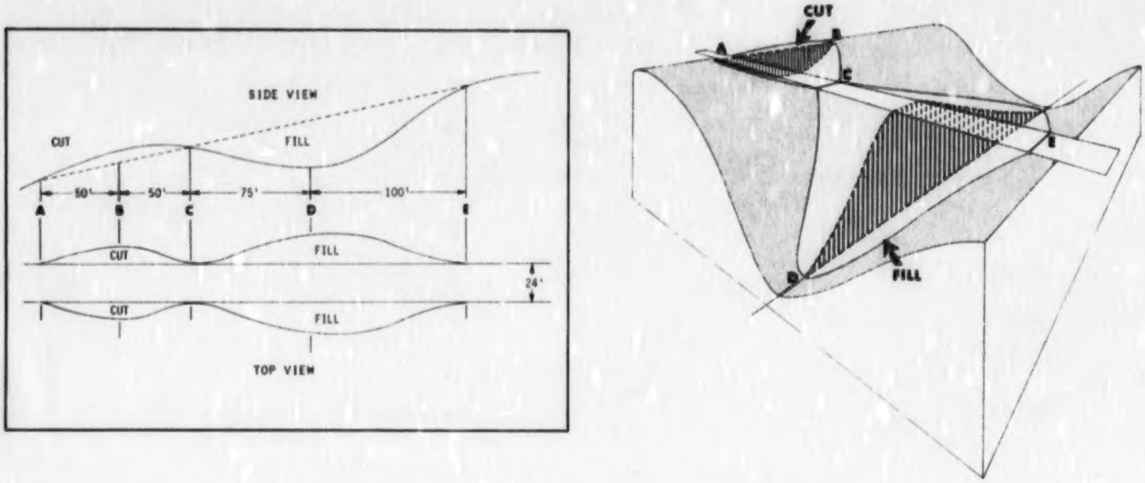
The volume between C and D = V_{C-D} = 1/54 X (450 + 0) X 30 yd^3

= 1/54 X 450 X 30 yd^3 = 250.0 yd^3

3. Total volume - 555.6 + 1388.9 + 250.0 = 2194.5 yd^3 of soil will have to be moved to cut the trench.

Example 2: A new road from the gate to the disposal area has to be put over the terrain illustrated in Figure E.2. Determine how much cut and fill you will have to finish the job.

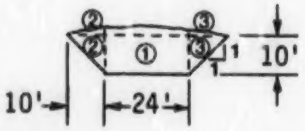
FIGURE E.2
Example road cut and fill


SIDE VIEW
CUT
FILL
50'
50'
75'
100'
A
B
C
D
E
CUT
FILL
24'
CUT
FILL
TOP VIEW
CUT
A
B
C
D
E
FILL

1. Area Calculations

Area A = $A_A = 0$

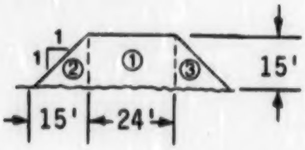
Area B = $A_B =$


②
③
②
①
③
1
1
10'
10'
24'

$= A_A = 0 \text{ ft}^2$
$= (\text{Area } 1) = (\text{Area } 2 \; \& \; 3)$
$= (24)(10) + 2\,(\tfrac{1}{2})(10)(10)$
$= 240 \text{ ft}^2 + 100 \text{ ft}^2$
$= A_B = 340 \text{ ft}^2$

Area C = $A_C = 0$

Area D = $A_D =$


1
1
②
①
③
15'
15'
24'

$= A_C = 0 \text{ ft}^2$
$= (\text{Area } 1) + (\text{Area } 2 \; \& \; 3)$
$= 24(15) + 2\,(\tfrac{1}{2})(15)(15)$
$= 360 \text{ ft}^2 + 225 \text{ ft}^2$
$= A_D = 585 \text{ ft}^2$

Area E = $A_E = 0$

$= A_E = 0 \text{ ft}^2$

2. Volume Calculations (Use Formula on Page 1 of this Appendix)

V_{A-B} = 1/54 (0 + 340)50 = 314.8 yd^3. cut

V_{B-C} = 1/54 (340 + 0)50 = 314.8 yd^3. cut

V_{C-D} = 1/54 (0 + 585)75 = 812.5 yd^3. fill

V_{D-E} = 1/54 (585 + 0)100 = 1083.5 yd^3. fill

3. Totals

Cut

V_{A-B} + V_{B-C} = 314.8 + 314.8 = 629.6 yd^3 of cut.

Fill

V_{C-D} + V_{D-E} = 812.5 + 1083.3 = 1895.8 yd^3 fo fill.

Therefore: 1875 - 629.6 = 1266.2 yd^3. of fill material must be borrowed to complete the road.

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY

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LAND QUALITY MANAGEMENT DIVISION

Staff	Located At	Mailing Address (same as above)
	5th Floor	
	Liberty Building	
	6th & Locust	
	Phone No. 515/281-4203	Emergency Phone No. 515/288-6819

The emergency phone number is for use only for disposal of radioactive materials or restricted chemicals after office hours (8:00-4:30, M-F).

Regional Office No.

Staff	Located At	Phone Number

Police:		Phone No.	
Fire:		Phone No.	
Ambulance:		Phone No.	
Other:		Phone No.	